

Final Report

**LITERATURE REVIEW - LITTER**  
A Review of Litter Studies,  
Attitude Surveys and  
Other Litter-related Literature

Keep America Beautiful



July 2007



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**LITERATURE REVIEW – LITTER**  
**Keep America Beautiful**

Table of Contents

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*Table of Contents*

*List of Tables*

*List of Figures*

**Section 1 SCOPE OF WORK**

**Section 2 INTRODUCTION**

**Section 3 LITTER SURVEYS**

3.1	IAR-Based Surveys.....	3-1
3.1.1	Key Findings of Visible Litter Studies .....	3-2
3.1.2	KAB vs. Non-KAB Areas.....	3-4
3.1.3	Adopt-a-Highway vs. Non – Adopt-a-Highway Roadways.....	3-5
3.1.4	Key Findings.....	3-6
3.2	Litter Surveys Utilizing Other Methodologies .....	3-8
3.2.1	Early Surveys (1969 – 1979) .....	3-8
3.2.2	Highway Research Board, National Academy of Sciences (1969) 3-9	
3.2.3	Virginia (1977).....	3-10
3.2.4	Kentucky (1979) .....	3-11
3.3	Trends .....	3-11

**Section 4 ATTITUDE SURVEYS**

**Section 5 KAB ORIGINAL RESEARCH**

5.1	Action Research Model.....	5-1
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**Section 6 LITTERING BEHAVIOR**

6.1	Arizona Research .....	6-1
6.2	Community Change – 1997 .....	6-1
6.3	Community Change – 2000 .....	6-4

**Section 7 MESSAGING**

**Section 8 CIGARETTE BUTT LITTER**

8.1 Introduction..... 8-1  
8.2 Cigarette Butts as a Source of Litter..... 8-2  
8.3 Workplace Smoking Bans ..... 8-3

**Section 9 EFFECTIVENESS OF LITTER RECEPTACLES**

9.1 Case Study – City of Long Beach, CA ..... 9-3  
9.2 Concerns Associated with, and Management of, Litter  
Receptacles ..... 9-3  
9.3 Conclusion ..... 9-4

**Section 10 COSTS OF LITTER**

**Section 11 ENFORCEMENT**

**Section 12 OTHER LITTER-RELATED ISSUES**

**Section 13 RESEARCH GAPS**

**Section 14 BIBLIOGRAPHY**

**APPENDIX**

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List of Tables

Table 3-1 Roadway Locale ..... 3-2

Table 3-2 KAB vs. Non-KAB - Visible Litter Items per Mile<sup>1</sup> ..... 3-5

Table 3-3 AaH vs. Non-AaH - Visible Litter Items per Mile<sup>1</sup> ..... 3-6

Table 3-4 Composition of Litter: IAR-Based Surveys ( 1993-2006) ..... 3-7

Table 3-5 HRB Litter Study ..... 3-10

Table 4-1 Summary of Litter Attitude Studies ..... 4-1

Table 6-1 ..... 6-2

Table 6-2 ..... 6-3

Table 6-3 ..... 6-5

Table 8-1 Annual Cigarettes Consumed in U.S. .... 8-1

Table 9-1 Effectiveness of Litter Control Receptacles ..... 9-2

Table 10-1 Average Cost of Litter Cleanups in Florida Communities (1999) ..... 10-1

Table 10-2 Summary of Iowa Litter Management Costs (2001) ..... 10-2

Table 10-3 Summary of State Highway Litter Cost Survey Results ..... 10-4

Table A-1 IAR-Based VLS Surveys ..... 1

Table A-2 Modified VLS Surveys ..... 4

Table A-3a Weight and Volume – Estimated Tons/Year<sup>1</sup> ..... 6

Table A-3b Weight and Volume – Estimated Tons/Mile<sup>1</sup> ..... 6

Table A-3c Weight and Volume - Product Categories by Weight ..... 7

List of Figures

Figure 3-1: Unintentional vs. Deliberate Litter ..... 3-4



# Section 1

## SCOPE OF WORK

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R. W. Beck has been contracted by Keep America Beautiful (KAB) to prepare an in-depth literature review of litter-related materials. The review specifically targets literature produced since 1990, however several important studies conducted prior to 1990 have been included to provide historical perspective and to establish a baseline of data with which to compare the current literature and data. The types of literature identified and reviewed include litter composition studies, attitude surveys, litter messaging, cigarette butt litter, and the efficacy of litter receptacles. Questions that were considered during the review process include:

1. Influence on littering behavior;
2. Relevance of age and gender relative to littering behaviors;
3. Cost of litter to state and local governments;
4. How much litter is considered unintentional vs. deliberate;
5. Replication of KAB's original research;
6. Other sources of litter;
7. Identifiable reasons people litter;
8. Key findings of major research to date;
9. Discrepancies between studies; and
10. Gaps in the research.

R. W. Beck has endeavored to research the topics outlined by KAB as thoroughly as possible given the time constraints, focusing on the topics and questions identified by KAB.



## Section 2

# INTRODUCTION

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Litter was once described as “one of the most neglected and most obvious forms of environmental degradation” (Anon). Although issues regarding the efficient disposal of garbage and trash have existed throughout history, the problems of litter as we know it began as refuse and garbage tossed in the streets, as detailed in Martin Melosi’s historical account of the ongoing struggle to deal with garbage and trash (Melosi, *Garbage in the Cities*). Melosi notes that this problem was a consequence, in part, of the Industrial Revolution and the development of cities in Europe.

Industrialization “produced the most degraded urban environment the world had yet seen” (Mumford, *The City in History*). These problems followed settlers to America with one profound difference. America had an abundance of open space. The mid-nineteenth century saw the implementation of boards of health and ordinances to attack this problem in the cities. Burgeoning population growth only made these problems worse.

Street departments and the American Public Health Association struggled to deal with these issues. Municipal responsibility for street cleaning was in place in seventy percent of the cities by 1880 (U.S. Dept. of Interior, Census Office, *Report on the Social Statistics of Cities*, Tenth Census, 1880), but the problems continued unabated. New York City attempted to address this problem in 1899 in a report to the Mayor’s office, in which City staff recommended curbside collection of trash and garbage. Boston, in 1915, experienced such unrestrained littering in the streets that the street cleaners could not keep up with it (*American Municipalities*, 1915). Cities had already adopted antilittering ordinances, but they were deemed unenforceable, and police were accused of disinterest. Various initiatives were tried, but all were subject to state and municipal financial constraints. This issue became possibly the most difficult environmental problem to solve simply because it was not the most pressing issue (George Steward, *Not So Rich As You Think*).

The end of World War II meant the end of the conservation ethic that had accompanied the war. The birth of a national highway system in the 1950’s provided automobile drivers with the opportunity to toss their refuse and garbage out of their car windows onto the roadsides.

This ongoing issue led to the creation of Keep America Beautiful (KAB) in 1953. KAB would become the first centralized group that would take on litter as a significant, quality-of-life issue. KAB emphasized individual and community responsibility for litter. Although the issues of litter continue to be a challenge, history suggests that progress has been achieved in addressing this problem.





## Section 3

# LITTER SURVEYS

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R. W. Beck reviewed 30 litter surveys conducted between 1989 and 2006 for this project. Of these thirty litter studies, twelve used a comparable methodology developed by the Institute for Applied Research (IAR). The IAR methodology involves using stratified random sampling techniques to visually count the total number of littered items (one inch or greater in size) on eight different roadway locale types. The results of the IAR surveys were compared by R.W. Beck to determine the breakdown between deliberate and accidental litter and other prevalent categories of litter. The remaining 18 studies conducted by various companies included a combination of item count, weight, and volume.

### 3.1 IAR-Based Surveys

IAR has studied the cumulative effects of litter on numerous locale types since 1975, when a comprehensive survey of California litter was first conducted. Early surveys (up to Hawaii 1988) mostly examined the volume of litter, the total number of littered items, and the disparity between fresh and accumulated litter. However, starting in 1988 the survey methodology was modified due to time and financial reasons to forgo the counting of fresh litter (in favor of counting accumulated litter) and the physical collection of the litter from roadways. The 1990 Louisiana study notes that “In two of our most recent surveys (Hawaii 1988 and Florida 1989) we developed a technique for visually classifying the composition of litter during a visible litter survey. Formerly it was necessary to laboriously pick up and sort thousands of items of litter. Using this method during the Louisiana 1990 survey, we were thus able to determine the approximate composition of the Louisiana litter by classifying the litter visually into one of 22 product or material subgroups”. The 22 product categories have remained largely unchanged since the 1990 study, and form the basis for the IAR visible litter studies (1990 to the present). The surveys we reviewed for this study used a similar methodology and produced comparable results. Data from the following IAR-based litter surveys were compared. Survey details are listed in the bibliography.

1. Tennessee – 2006
2. Georgia – 2006
3. New Jersey – 2004
4. North Carolina – 2001
5. Mississippi – 2000
6. Pennsylvania – 1999
7. Oklahoma – 1998
8. Kentucky – 1998
9. Hawaii – 1993
10. Texas – 1991



11. Louisiana – 1990
12. Washington – 1990

### 3.1.1 Key Findings of Visible Litter Studies

Table A-1 displays the key findings of the twelve studies listed above. The project team analyzed the number of sites sampled per study; the top five sources of litter (by percent) for each study; accidental vs. deliberate litter; the visible litter items per mile between KAB and non-KAB communities; the visible litter items per mile between Adopt-a-Highway and non-Adopt-a-Highway roadways; and other key findings for each study (where applicable). More detailed results are provided in the Appendix. Note that some of the other surveys used variations (minimum size of items counted, for example) of the IAR methodology, and were therefore determined to not be directly comparable.

IAR-based surveys divide all roadways within each state into one of eight possible locales, each having unique characteristics. The roadway locales, acronyms used in this report and description of the road type are listed in Table 3-1.

**Table 3-1  
Roadway Locale**

Roadway Type	Acronym	Description
Rural Freeways and Toll Roads	RFT	Interstate highways, non-interstate toll roads and limited access highways located outside of urban areas.
Other State Rural Highways	OSR	U.S. and State highways located outside of urban areas without limited access.
Rural Local Roads	RLR	Public roads outside of an urban area that are locally maintained (e.g. city, county)
Urban Freeways and Toll Roads	UFT	Interstate Highways, non-interstate toll roads and limited access highways located within an urban area.
Vacant, Industrial or Un-maintained Street Frontages	VIU	The edge of an urban street in front of a vacant lot, industrial site or a lot with a building and or landscaping which is not maintained.
Commercial Street Frontage	COM	The edge of an urban street in front of a business such as stores, restaurants and shopping centers.
Public Facility Street Frontage	PUB	The edge of an urban street in front of a government or quasi-public use building such as a courthouse, park, school or public library.
Residential Street Frontage	RES	The edge of an urban street in front of homes on neighborhood streets.

## Number of Sites Sampled

The average number of sites sampled for the 12 IAR-based visible litter surveys was 112. It was unclear how many sites were sampled during the Washington 1990 study. In addition, during the Texas 1991 study, 234 sites were sampled. If the number of sites sampled in Texas is removed from the equation, the average number of sites sampled per state is 100.

## Top Five Sources of Litter

R. W. Beck reviewed all 12 IAR-based litter studies and broke out the top five sources of litter (by percent) for each study. Two of the 12 studies (Texas 1991 and Washington 1990) did not list the percent breakout by litter item category. However, the results of the remaining 10 studies are listed in Table A-2. It is important to note that several studies grouped product categories together making it difficult to compare one item to another. For instance, in Oklahoma 1998, vehicle debris, metal, glass, paper, and wood products were grouped together. In most other studies these materials were separate categories. A brief overview of the results shows that:

- Miscellaneous paper and plastics were ranked either number 1 or number 2 in five of the 10 studies.
- Vehicle Debris and packaging comprised a high amount of the visible litter found in the 10 studies. The data shows that vehicle debris was ranked in the top five (by percent) in seven of the 10 studies.
- Beverage containers and related litter were ranked first or second in only two studies (North Carolina 2001 and Mississippi 2000). Beverage-related litter was the third highest by item count in Hawaii and Louisiana, fourth highest in Oklahoma and Kentucky, and fifth highest in Pennsylvania. Beverage-related litter did not rank in the top five product categories by item count in the last three litter studies - Tennessee, Georgia, and New Jersey.

## Accidental vs. Deliberate Litter

One of the major issues involving litter assessment is the determination of whether an item was likely to have been littered deliberately or carelessly. The IAR methodology breaks the 22 product categories into one of these two litter categories. IAR defines accidental litter as “material or products that are usually seen being deposited unintentionally, such as vehicle debris from accidents or wear, material that falls from loaded vehicles and items that fly out of open bed vehicles. It includes items that spill from overloaded or tipped trashcans and items dropped or left behind unintentionally by persons”. Deliberate litter on the other hand is defined as “material or products that are usually seen being thrown, dropped, discarded, or left behind intentionally in inappropriate locations”. Examples of deliberate litter include snack food wrappers, take-out food packaging, and beverage containers. Previous IAR-based surveys had used the term “accidental” to represent litter that may not have been intentionally tossed out onto roads and sidewalks. During the 2006 Georgia Litter study, R. W. Beck changed the term “accidental” to “negligent” to insinuate more of a need for the litterer to accept responsibility. That term was also used by R. W. Beck in the

Tennessee Litter Survey. KAB prefers to use terms “careless” or “unintentional” to refer to litter that is suspected not to be intentionally disposed of improperly.

Figure 3-1 provides a summary of the portion of unintentional vs. deliberate litter in the studies reviewed.

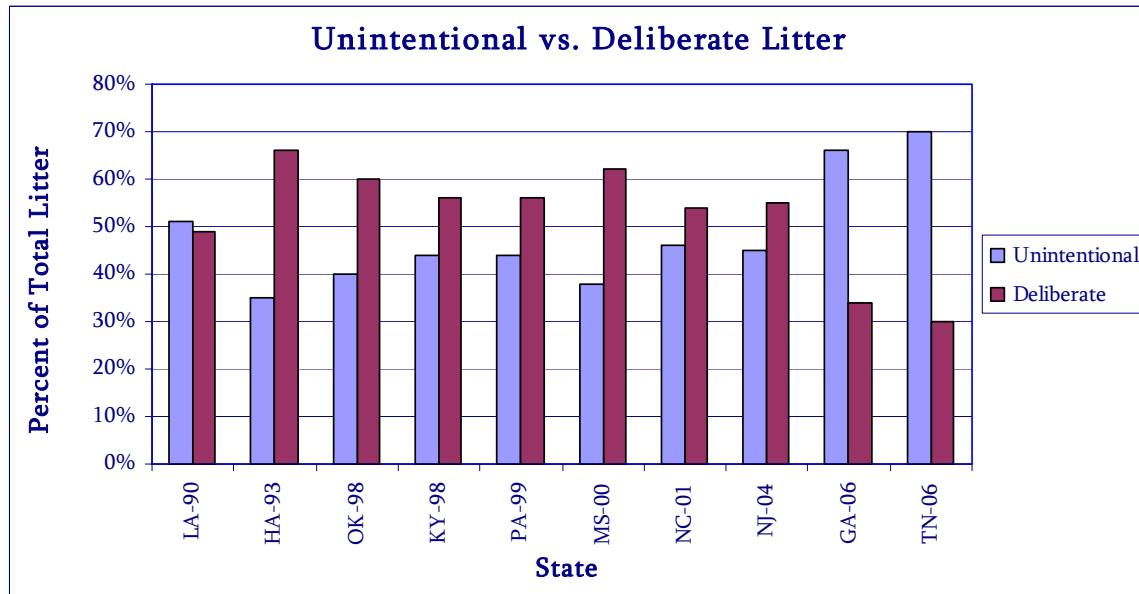


Figure 3-1: Unintentional vs. Deliberate Litter

Data regarding the breakdown between intentional and deliberate litter suggests a possible trend of less deliberate litter over time and a growth in unintentional litter. IAR reviewed 31 litter surveys that had been conducted through 1986 and found that 64.5 percent of litter was deliberate while only 35.5 percent was unintentional. Beginning with in 1990, some of IAR reports showed this breakdown. The 1990 Louisiana survey showed slightly more deliberate litter (51 percent) than unintentional (49 percent). Figure 3-1 shows the breakdown between these two categories of litter, starting with the 1986 surveys and following through the Tennessee 2006 survey. The trend seems to indicate an increase in unintentional litter as opposed to deliberate litter.

In the 1998 Kentucky visible litter study, IAR demonstrated a reduction in the percent of deliberate litter from 74 percent to 54 percent when comparing changes in Kentucky’s litter from the base year of 1980. Previous IAR studies indicate that deliberate litter is a larger percent in urban areas than in rural areas.

### 3.1.2 KAB vs. Non-KAB Areas

Since state Keep America Beautiful affiliates focus so intently on litter-related issues, many IAR studies have compared litter rates between communities with KAB affiliates, and those without. According to the New Jersey 2004 litter survey, “The results for 272 combined small and large county samples showed that KAB sites were

8.5 percent cleaner than the non-KAB sites”. Of the 12 IAR-based litter studies reviewed, six compared KAB vs. non-KAB sites. Five of the six states sampled showed that KAB sites were less littered than non-KAB sites. Only in the 1999 Pennsylvania study (Philadelphia County only) were KAB sites more littered than their counterparts. Table 3-2 shows the comparison of the six states in detail.

Table 3-2  
KAB vs. Non-KAB - Visible Litter Items per Mile<sup>1</sup>

State	Year	KAB vs. Non-KAB
Tennessee	2006	1,124 vs. 1,389
Georgia	2006	N/A
New Jersey	2004	N/A
North Carolina	2001	950 vs. 1,450
Mississippi	2000	1,800 vs. 2,100 (Multi-County sites)
Pennsylvania	1999	2,751 vs. 1,980 (Philadelphia Co. only)
Oklahoma	1998	N/A
Kentucky	1998	1,413 vs. 1707 (Litter Reduction Programs) <sup>2</sup>
Hawaii	1993	N/A <sup>3</sup>
Texas	1991	Only showed % reduction between sites, no comparison.
Washington	1990	N/A
Louisiana	1990	24% lower <sup>4</sup>

<sup>1</sup> Some numbers have been rounded

<sup>2</sup> Performed for Louisville & Covington urban areas only. Includes AaH and other reduction efforts

<sup>3</sup> Results based on 12 of 14 rural state highways and rural freeways on Maui and Oahu.

<sup>4</sup> Results based on comparing 10 adopted rural state highways vs. 13 non adopted rural state highways.

### 3.1.3 Adopt-a-Highway vs. Non – Adopt-a-Highway Roadways

IAR-based litter surveys have also compared the litter rates between adopted roadways and those that have not been adopted. In some states no statistically significant conclusions were drawn if the sample size was too small. The 2004 New Jersey report concluded that the visible litter rate for adopted highway sites sampled from the most recent nine surveys (including New Jersey) was 9.5 percent lower than the rate for non-adopted sites. In Tennessee 2006, adopted sites averaged twice as clean as non-adopted sites. Survey results showed 311 visible items per mile in adopted sites, while non-adopted sites averaged 610 visible items per mile. In Georgia 2006 adopted sites averaged 13.1 percent cleaner than non-adopted sites. These trends do not hold true for all states. In Mississippi 2000, for example, adopted sites were, on average, 89 percent more littered than non-adopted sites. It is important to note that adopted sites may be targeted because they are litter hot-spots and thus may yield higher litter rates compared with non-adopted sites that are not considered hot-spots. Table 3-3, where possible, breaks out the comparison between states.

**Table 3-3**  
**AaH vs. Non-AaH - Visible Litter Items per Mile<sup>1</sup>**

State	Year	AaH vs. Non-AaH
Tennessee	2006	311 vs. 610
Georgia	2006	1,074 vs. 1,236
New Jersey	2004	1,532 vs. 1,756
North Carolina	2001	1,250 vs. 1,350
Mississippi	2000	3,600 vs. 1,900
Pennsylvania	1999	1,582 vs. 2,969
Oklahoma	1998	N/A
Kentucky	1998	N/A
Hawaii	1993	AaH < 54% Non-AaH <sup>2</sup>
Texas	1991	N/A
Washington	1990	N/A
Louisiana	1990	N/A

<sup>1</sup> Some numbers have been rounded

<sup>2</sup> Results based on 12 of 14 rural state highways and rural freeways on Maui and Oahu.

### 3.1.4 Key Findings

#### Composition of Litter

R. W. Beck analyzed the results from nine of the 12 litter surveys that utilized an IAR-based methodology. An in-depth analysis of the composition of 11 different types of litter categories measured in these nine states is detailed in Table 3-4 below. The results show that of the 11 litter categories, snack wrappers comprised the largest percent of littered items at almost 13 percent. Miscellaneous paper and plastic were 12.1 and 12.0 percent respectively. Take out food packaging, which has a reputation of being one of the more abundant types of litter on our roadways, on average comprised only 4.1 percent of the total visible items on state roadways. As Table 3-4 illustrates, when the average incidence of all the 11 product categories is summed for the nine surveys, it comprises just over 87 percent of the total visible litter.

Table 3-4  
Composition of Litter: IAR-Based Surveys (1993-2006)

State & Year	Takeout Food Packaging	Snack Wrappers	Misc. Paper	Misc. Plastic	Vehicle Debris	Beverage Containers	Napkins, Bags, Tissues	Misc. Metal & Glass	Other Beverage Related	Construction Debris
TN 06	6.7%	9.7%	18.0%	21.1%	14.5%	5.2%	1.8%	9.2%	3.9%	4.0%
GA 06	9.7%	9.4%	18.6%	22.3%	9.1%	4.4%	4.6%	8.2%	2.8%	1.3%
NJ 04	14.3%	9.3%	12.9%	7.7%	4.4%	9.2%	6.9%	8.0%	5.0%	1.9%
NC 01	11.1%	14.5%	16.2%	7.4%	7.5%	11.1%	6.3%	2.5%	4.2%	4.3%
MS 00	19.7%	9.3%	9.1%	6.7%	7.4%	13.1%	7.0%	3.1%	4.4%	5.4%
PA 99	N/A	21.0%	7.0%	N/A	13.0%	5.1%	N/A	N/A	3.6%	6.0%
OK 98	N/A	15.0%	N/A	N/A	N/A	12.4%	N/A	N/A	N/A	N/A
KY 98	15.7%	12.7%	8.3%	7.9%	12.1%	8.6%	4.2%	1.7%	4.6%	7.5%
HI 93	14.4%	15.1%	7.0%	10.8%	2.5%	7.3%	13.4%	2.2%	5.3%	3.2%
<b>AVG:</b>	<b>13.1%</b>	<b>12.9%</b>	<b>12.1%</b>	<b>12.0%</b>	<b>8.8%</b>	<b>8.5%</b>	<b>6.3%</b>	<b>5.0%</b>	<b>4.2%</b>	<b>4.2%</b>



## 3.2 Litter Surveys Utilizing Other Methodologies

Other surveys that use a methodology other than the IAR methodology were also identified. These surveys are listed below with the methodology type noted in parentheses. Additional information regarding these reports can be found in the bibliography.

1. Texas – 2005 (Item Count, Weight and Volume)
2. Mississippi – 2004 (Item Count and Volume)
3. Ohio – 2004 (Weight and Volume)
4. Washington – 2004 (Weight and Volume)
5. Florida – 2002 (Item Count)
6. Florida – 2001 (Item Count)
7. Nebraska – 2001 (Item Count and Weight)
8. Iowa – 2001 (Item Count)
9. Texas – 2000 (Item Count, Weight and Volume)
10. Florida – 2000 (Item Count)
11. Florida – 1999 (Item Count)
12. Florida – 1998 (Item Count)
13. Florida – 1997 (Item Count)
14. Florida – 1996 (Item Count)
15. Florida – 1995 (Item Count)
16. Florida – 1994 (Item Count)
17. Pennsylvania – 1992 (Item Count)
18. Nebraska – 1991 (Item count, Weight, and Volume)
19. New Jersey – 1989 (Item Count, Weight and Volume)

Instead, these studies used either a modified item count methodology that was not directly comparable to the IAR methodology or a methodology that focused on weight and/or volume. Eight of these 19 surveys (Florida 1994 through 2001) were not reviewed in-depth as the results of the 1994 thru 2001 study were included in the Florida 2002 report. Due to the large amount of data reviewed, Table A-2 (Modified VLS) and Tables A-3a-d (Weight and Volume) show the compilation of the data for all of the surveys reviewed. These tables display the key findings and other relevant information related to each of the 10 studies which are also discussed elsewhere in this report.

### 3.2.1 Early Surveys (1969 – 1979)

Although this literature review focused on litter surveys conducted within the last 10-15 years, it was deemed important to review several older surveys in order to have a baseline of data with which to compare results. While these older surveys were not always directly comparable to recent surveys, they provided interesting information about the state of litter at the time. These surveys include:

1. Highway Research Board (National Academy of Sciences) – 1969
2. Virginia – 1977
3. Kentucky – 1979

### 3.2.2 Highway Research Board, National Academy of Sciences (1969)

A national study of roadside litter was conducted by the Highway Research Board of the National Academy of Sciences (HRB) in 1969. Using data collected from 29 states, a profile of the nation's litter composition was developed. Paper products were found to be the largest component of litter. Miscellaneous paper was found to constitute 46 percent of litter, much more than newspapers/magazines (1.9 percent) or paper packages and containers (11.5 percent). The estimated volume of accumulated litter was about one cubic yard per mile, while fresh litter totaled 0.6 cubic yards per mile.

The total volume for the second pickup (fresh litter) was about 40 percent of the total from the initial pickup (accumulated litter). The report noted that most states showed a similar pattern of litter composition and a correlation between average daily traffic and total litter volume, a factor IAR would later utilize in its surveys. Site selections were based on total mileage and a random selection factor. IAR would later develop a more complex method to select sites, considering these and a number of other variables.

Table 3-5 shows the item count from the accumulated and fresh litter counts. The characterization in both counts is similar, although the amount of cans (mostly beer cans) was much lower in the second (fresh) count.

The importance of this benchmark survey is that it helps us understand the changing components of litter. When this survey was conducted, 48.9% (almost half) of all accumulated litter was paper products while beverage containers constituted 28.3 percent of accumulated litter. While there are some differences in methodology, this survey used a count method similar to the one adopted later by IAR and thus, some comparability is possible. Some products characterized by IAR as food packaging or napkins may have been characterized as paper in the 1969 study, the percentage is still significantly lower than the total for paper that the HRB study yielded. An average of nine recent litter surveys suggests that paper averages about 12.1 percent of accumulated litter while beverage containers average about 8.5 percent, a change in the characterization of litter.

Table 3-5  
HRB Litter Study

Litter by Item Class	Accumulated Litter		Fresh Litter	
	Items/Mile	Percent	Items/Mile	Percent
Paper	1,605	48.9%	776	59.5%
Cans	929	28.3%	213	16.3%
Misc. Items	364	11.1%	163	12.5%
Bottles and Jars	227	6.9%	77	5.9%
Plastic Items	155	4.7%	75	5.8%
<b>Total</b>	<b>3,280</b>	<b>100.0%</b>	<b>1,304</b>	<b>100.0%</b>

### 3.2.3 Virginia (1977)

In 1977, Stephen R. Runkle sampled litter from 82 total sites throughout the state for the Virginia Highway & Transportation Council. The purpose of the study, which included item, volume, and weight count, was to determine the proportion of various litter types as specified by the Virginia Litter Control Act. Of the 82 sites that were sampled, 61 were classified as Highway, 11 sites were classified as Urban, and 10 sites were classified as recreational. The Virginia Litter Control Act stipulates that litter be classified into a minimum of 15 categories in order to enable the equitable taxation of various litter industry groups for the funding of future litter control programs. The resulting analysis of the specified product categories showed that beer, soft drink, liquor and wine-related products comprised nearly 41 percent of the items by count.

Take-out food packaging was second with nearly 15 percent by count, while tobacco-related products comprised nearly 8 percent of the overall litter by count. When analyzed by weight, the top three product categories were:

1. Beer, soft drink, liquor and wine – 64.8 percent;
2. Grocery products (which generally is a food container or wrapper of some sort with the exception of snack food items and paper bags identified as coming from a grocery store) – 6.0 percent and
3. Miscellaneous paper – 5.8 percent

In addition to item count and weight, Runkle performed a volume count. As with the weight count, beer, soft drink, liquor and wine comprised the largest area by volume – 37 percent; followed by grocery products at 17.8 percent, and take-out food packaging at 12.4 percent. While the Runkle report provides a snapshot of the composition of litter in the State in the late 1970's, R. W. Beck noted the potentially unrepresentative stratification of sample sites (61 Highway, 11 urban, 10 recreational). In addition, it is unclear whether cigarette butts were counted.

### 3.2.4 Kentucky (1979)

IAR conducted one of its early litter surveys in Kentucky in 1979. Data from this survey was referenced in IAR's 1998 update survey in Kentucky, and is therefore provided above. Many of the details reported in this study are notable. Findings include comparison of accumulated litter versus fresh litter, which had also been considered in the earlier Highway Research Board's 1969 litter survey. Other data calculated included items littered per person. It is uncertain how appropriately short-term field counts of vehicular and pedestrian counts translate into 24-hour values based on data points acquired during the survey. Nevertheless, it is clear that a significant level of effort was expended in an attempt to derive meaningful results from the raw survey data. As was the case for many of the IAR surveys, a significant amount of clearly described detail regarding study methodology is provided.

## 3.3 Trends

In addition to the changes in suspected sources of litter (unintentional vs. deliberate), there is evidence that littering as a whole has dropped. IAR issued a report in 2006 comparing the litter rate for the 62 surveys that had been conducted using its methodology over the last 30 years. The conclusion was that rate of litter has been trending downward at an average rate of about 2 percent per year. This regression analysis took into account 8 major factors that were determined by IAR to significantly affect litter rates: vehicular and pedestrian traffic, median income, occupants per vehicle, rain/temperature index, population, miles to city and number of years that a litter program had been in place. This change in trend does not apply to cigarette butt litter, which is less than one square inch and was not counted in most roadside litter surveys.

R. W. Beck's 2006 surveys in Georgia and Tennessee noted an increase in unintentional litter, which includes a number of smaller items such as miscellaneous paper and plastic, and a decrease in deliberate litter.

It is notable that curbside recycling programs began to proliferate between 1988 and 1994. These programs have successfully diverted a significant amount of material from landfills. However, these programs have also created twice the number of vehicles collecting materials from residential areas. To the extent that trash vehicles may be responsible for negligent spillage, curbside recycling vehicles have now doubled the number of vehicles potentially causing spillage of additional materials, not littered deliberately, but negligently. When the data is viewed as a whole, litter reductions may not be as apparent. When this data is broken out between those items that are negligently or deliberately littered, the reduction in intentional litter is more evident (Fig. 3-1).

The drop in overall litter rates along with a suspected increase in unintentional litter over the past 15 years suggest that litter reduction education and cleanup efforts may have been successful in reducing deliberate litter that is greater than one square inch in volume and that unintentional litter should be an important focus in the future to achieve further reductions in litter.



## Section 4

# ATTITUDE SURVEYS

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The following Attitude surveys were identified and reviewed. The type of survey conducted is noted in parentheses. Additional details about these surveys are included in the bibliography.

1. Tennessee – 2006 (phone)
2. Georgia – 2006 (phone)
3. Iowa – 2001 (mail survey)
4. Mississippi – 1999 (focus groups)
5. Washington – 1999 (phone/focus groups)
6. Texas – 1998 (phone)
7. Australia – 1997 (interviews)
8. Human Resources Institute – 1974
9. Public Opinion Surveys, Inc. – 1968 (N/A)

The questions asked in each of these surveys were not always comparable, due in-part to the way in which questions were framed. In some cases the report did not indicate details of the survey questions as much as hoped. Where possible, responses to similar questions were compiled. At times, surveys conducted by phone engendered different responses compared to focus group comments. Of the nine surveys, eight were comparable and are included in this review.

The ages of those interviewed were limited, with three of the eight surveys limiting their respondents' age to 18-45 years. While this might have achieved the goal of focusing on groups considered to be more persistent litterers, it limited the responses, and therefore did not allow a broader comparison of results. Littering by younger people has created a unique dynamic. Surveys show that younger people may litter more in certain situations, but may also be more likely to admit that they have littered (Community Change Consultants). Younger people may not have identified themselves as community members in the way that adults tend to do. The unique challenge is educating a constantly changing group of upcoming youth. A comparison of responses from the eight attitude surveys is shown in Table 4-1.

The 1975 Action Research Model report conducted by the Human Resources Institute (HRI), replicated studies that had been conducted the prior year by the American Public Works Association (APWA). This study found that perceptions of litter varied with the location. The same amount of litter in the same area was deemed more severe by suburbanites compared to urban dwellers. In addition, women rated litter more severely than men and many people rated an area as “heavily littered” when the streets were clean, but other blights were present, such as weeds at the median, oil-stained pavement, or broken curbs.

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## Section 4

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HRI noted an infinite number of variables influencing littering, but identified four groups as being critical to change. Those groups and the attitudes associated with them are:

1. Motorists and pedestrians – It's ok to litter in littered areas and where someone else will clean up.
2. Gatekeepers (community decision-makers) – We've always done it like this and it's someone else's responsibility.
3. Witnesses – The norm is not to become involved and to avoid confrontation with litterers or gatekeepers.
4. Victim – No one else cares - why should I? You can't fight city hall. Others are responsible – not me.

Scott Geller conducted several attitude-related studies. These studies did not provide enough data to be included in the matrix of attitude surveys, but his results are worth noting. In a behavioral study conducted in 1976, Geller's group distributed handbills to more than 18,000 supermarket patrons to help determine which gender litters more. The handbills were inconspicuously marked to distinguish between those given to males and females. The sample size was large enough to have produced meaningful results. He determined that it was safest to note that any person could be a litterer in a specific situation and that the most effective strategy is to alter the situations themselves. Gender was determined not to be a factor in littering in this specific setting, a finding echoed by Community Change Consultants, but disputed by the Institute for Applied Research. Geller references a study finding that, although females are as likely to litter as males, they are less likely than males to admit to littering.

Several of the surveys focused on younger audiences as the presumed targets for their surveys. While this provides more information about the opinions of youth, it may miss key observations about how older adults view litter issues. Still, five of the eight surveys' respondents believed that younger people litter more than adults, while two did not address the subject and only Community Change Consultants disagreed. A different five agreed that males litter more than females, while two did not broach the topic and again only Community Change Consultants disagreed.

Litter was considered an issue to some extent by all surveys, but the responses depended heavily on how the question was framed. In Georgia only 2 percent of respondents mentioned litter as a problem, unprompted. When asked specifically about litter, 87 percent agreed that it was an issue. In Washington, 79 percent said litter was an important issue, but only 38 percent said it was very important. In Texas 64 percent said negligent litter was a problem, but only 36 percent thought candy wrapper litter was important.

In a recent survey conducted for the Philadelphia Streets Department by Levlane Advertising, 66 percent of 285 singles polled indicated they would not date someone that they have observed littering. When asked if they would tell their date to stop littering, 71 percent said yes. Additional information about this survey was not available at the time this report was due.

Table 4-1  
Summary of Litter Attitude Studies

	KAB	Australia	Texas	Washington	Mississippi	Iowa	Georgia	Tennessee
Year Conducted:	1968	1997	1998	1999	1999	2001	2006	2006
Medium:	Phone (?)	Interviews	Phone	Phone/Focus	Focus Groups	Mail Survey	Phone	Phone
Interviews/Participants:	n/a		1,201	300	36	2,217	1,004	600
Age focus:			51% = 40+	18+	18-45	70.6% male, 1% under 25, 20% (65+)	18-30	18-34
Yes, Litter is a problem:	36% <sup>2</sup>	78%	64% (negligent), 47% (butts), 36% (candy wrappers), 56% (chip bags)	38% said it was very important; 79% said it was important		57%	2% Mentioned Litter w/o prompting; 87% Agreed when asked; 3	62%
Young people litter more:	Yes	Depends on alone or with group	Yes (16-24)	Yes (13-24)		Yes	Yes	
Gender of those who litter most:	Male	No Difference	No Difference	Male		Male (10 to 1)	Male	Male
Do you personally litter:	49%		52% (in past few years)		Most in past few days	43% (small items)	46%	48% (within previous year)
Did admissions to littering decrease with age:		Yes				Yes	Yes	Yes



## Section 4

	KAB	Australia	Texas	Washington	Mississippi	Iowa	Georgia	Tennessee
Year Conducted:	1968	1997	1998	1999	1999	2001	2006	2006
Medium:	Phone (?)	Interviews	Phone	Phone/Focus	Focus Groups	Mail Survey	Phone	Phone
Is littering ever acceptable?		76% (No)		No receptacle nearby,		Yes - minor issue.	95% (No)	
Would you report a litterer:	No		32% (Yes), 35% (Might)	49% (Very Likely)	Reluctant	67% (Yes)	58% (Yes)	
Why do people litter:	Careless, Lazy, Availability	Laziness		Don't Care (86%), Doesn't Matter (81%)	Lack pride, inadequate enforcement	Minor issue, accidental	Lazy, Availability	
Litterers are unlikely to get caught:	46%				Almost unanimous		72%	97% (all the time)
Admitted litterers - feel remorse:		64%				Not so much.	49%	
Have you seen or heard a litter message:	90%+	80%	66%		Low	24.4% (last 3 months); 50.2% (past year)	48%	40% (past month)
Have you seen or heard a litter message on TV:	90%				Low			51%
Remember message:			62%				50%	
Awareness of AntiLitter Organization:	2% (KAB)				Very low		8% (KGB)	
Litter messages are effective:				57%			76%	83.6% <sup>1</sup>

## ATTITUDE SURVEYS

	KAB	Australia	Texas	Washington	Mississippi	Iowa	Georgia	Tennessee
Year Conducted:	1968	1997	1998	1999	1999	2001	2006	2006
Medium:	Phone (?)	Interviews	Phone	Phone/Focus	Focus Groups	Mail Survey	Phone	Phone
Aware of programs: AaH			82%		Few		42%	
Biodegradable items are litter		No				Minor issue		58%
Admitted littering cigarette butts			16%			18%		52%
Enforcement would stop littering			Yes	8% <sup>4</sup>		70%		81%
Predictors of Littering by Gross Litterers:			Single (63%), Bars (51%), Long Drives (44%)	Driving (55%), Outdoor Recreation (14%)		Uncovered vehicles, teens hanging out, visitors		
Items that are minor litter problems:		Apple cores (38% said not litter); Organic, no bins available, someone will collect it;	Candy wrappers (20%), Butts (18%), Paper (15%)	vehicle parts		food (80.4%), butts (79.6%), paper (44.8%), fast food cont. (43.2%)		

### Notes to Survey Comparisons

GA: Young respondents reacted negatively to "Only Losers Litter," saying it was not effective, when in reality, it was very effective because it bothered them.

<sup>1</sup> Litter laws are never or rarely enforced.

<sup>2</sup> Have talked with neighbors about the litter problem.

<sup>3</sup> When asked about the important quality of life issues in Georgia, 2% mentioned litter without prompting; 87% agreed when asked specifically about litter affecting quality of life.

<sup>4</sup> Only 8% recommended fines as an effective method of reducing littering.



## 5.1 Action Research Model

In 1975, KAB completed a three-year research project whose purpose was to develop a behaviorally-based systems approach to significantly reduce litter in communities. To this end, KAB contracted with the Human Resources Institute in Morristown, NJ to develop the Action Research Model (ARM). The goal was to identify and modify the norms that tend to sustain littering behavior.

Research identified littering norms, seven major sources of litter and four components identified as “pressure points” which, when addressed effectively, could significantly reduce litter.

The ARM was field tested for more than a year in three demonstration sites: Charlotte, NC, Macon, GA and Tampa, FL. Litter reductions of at least 60% were achieved for each of these communities in the first year of the program. Sustained reductions were also noted.

In documenting the problem of litter, the report noted that even effective anti-litter programs are challenged by increases in population, leisure time and mobility, which have exacerbated this problem. Confusion was noted as to both the definition and perceived severity of litter. The study began by defining litter as uncontainerized solid waste.

Preliminary research identified four groups of people whose norms are critical to change in litter dynamics:

1. Motorists and pedestrians
2. Gatekeepers
3. Witnesses
4. Victims

The importance of achieving measurable results was noted, as activity by itself would demoralize volunteers in the end without accompanying results. KAB contracted with the American Public Works Association (APWA) to develop a photometric index which would measure the accumulation of litter utilizing a random sampling methodology.

The ARM was intended to use a comprehensive process calling for:

1. Getting the facts (e.g., taking into account trash-handling practices)
2. Involving the people (precluding the need for outside specialists)
3. Developing a systematic approach (identifying sources of litter and components of the model)

## Section 5

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4. Focusing on results (quantifiable reductions measured against a base line)
5. Providing positive reinforcement (through publicity, awards and an emphasis on community values)

The components of the model, when applied together, were seen as a comprehensive and systematic approach to reducing litter. The included:

1. Sensible, comprehensive regulations (including a model ordinance)
2. Modern sanitation equipment and practices (best practices for waste handling)
3. Continuous education
4. Vigorous enforcement

Demonstration sites were selected based on demographic variety, reasonable size, suitable climate, representative bureaucratic structure, typical of most communities, community interest and the motivation and effectiveness of elected officials and the Public Works staff.

While conducting the base line measurements, field staff noted that the area from the curb to the property line were littered in most communities, while the streets tended to be litter-free.

The ARM also called for establishing an 'attitudinal base line' study. While different groups expressed interest in conducting these surveys, they found them too complex. Although a modified sampling design and questionnaire were developed, community awareness was too widespread to allow for 'before and after' comparisons.

APWA conducted analysis of Charlotte's solid waste system and recommended limited set-out times, containerization of commercial waste and ordinances requiring property owners to keep their premises litter-free, more effective street sweeping schedules and improved maintenance of city-owned vacant lots.

Macon noted such issues in their system such as the need for improved containerization of household waste, additional receptacles in public areas, maintenance of vacant lots, more street sweeping and collection of commercial waste.

Tampa found that problems with illegal dumping, sanitation jurisdiction over off-street public property, inadequate litter receptacles and inadequate trash collection equipment as major contributors to the litter problem.

After determining the facts, the next step was assembling a broad-based citizens' committee to assume responsibility for implementing the ARM. Macon had little difficulty making use of their existing KAB affiliate while Charlotte and Tampa took some time to complete this process.

Evidence of success included additional funding for anti-litter programs and the institutionalization of the Clean City Committees. The development of comprehensive code added to the effectiveness of anti-litter ordinances including the requirement for containerization of all waste.

ARM also created positive responses from DPW management, which purchased new equipment such as additional litter receptacles, new street sweepers, dumpsters and the trucks to service them.

The same climate that supported more vigorous enforcement and the hiring of additional enforcement officials also resulted in a significant increase in voluntary compliance.

While the ARM was a comprehensive and credible approach to documenting the state and changes of littering in communities, it was self-described as “complex in execution” and noted the significant investment of time and human resources in order to be successful.

However, litter had been measurably reduced through the implementation of this program and people had learned that they could effect change.



## Section 6 LITTERING BEHAVIOR

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### 6.1 Arizona Research

Arizona State University conducted research in 1998 regarding littering-related behavior. The purpose of this study was to provide information that would help Arizona Clean and Beautiful minimize litter and encourage recycling.

Two research methods were used: a survey mailed to random utility customers in urban areas and a survey administered onsite to visitors in five recreational areas in the same areas. Findings from both surveys showed comparable responses to similar questions.

Results from these surveys correspond with results from other litter attitude studies conducted. Those who have the strongest community bonds and frequent recreational areas feel the highest obligation not to litter. Littering rates were lower in areas where community recycling was available.

Respondents felt that they do not litter and that others who don't care are responsible. They also believe that others litter because they think someone else will clean up for them. Other reasons for littering include a lack of trash cans.

The study also found that people are more likely to respond to verbal communications over print notices.

Overall, the results of this study support KAB's original findings that people tend to litter more in an area that is already littered and that people will litter more if they believe that someone else will clean up after them.

### 6.2 Community Change – 1997

Considerable research regarding litter has been conducted in Australia by Community Change Consultants. A unique study was conducted whereby teams of observers and interviewers were set up so that one team would observe people either littering or using a litter receptacle. The observing team would then contact the interviewing team and describe the person and location. The interviewers would then interview the person without knowing whether the person had littered or used a receptacle. This created a unique opportunity to compare attitudes and behavior.

A total of 8,968 observations and 2,694 interviews were conducted in the eight states of Australia between February and May 1997.





## Section 6

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Particular attention is paid to the gender and age of observed litterers, which was noted by the observers. The report notes that women and men were equally likely to litter, the compiled data suggests that, overall, males make up a slightly larger percent of observed litterers. Interestingly enough, the two most southeastern states, Tasmania and Victoria, showed the greatest percentage of male litterers.

Table 6-1

Community Change: Gender of Litters - 1997					
Gender	Male	Female	All Ages	Male	Female
Tasmania	132	92	224	59.0%	41.0%
Victoria	181	115	296	61.0%	39.0%
Canberra	143	149	292	49.0%	51.0%
Sydney	136	107	243	56.0%	44.0%
Brisbane	165	158	323	51.0%	49.0%
Adelaide	126	103	229	55.0%	45.0%
Perth	135	101	236	57.0%	43.0%
Darwin	153	115	268	57.0%	43.0%
<b>Total/Average</b>	<b>1,170</b>	<b>941</b>	<b>2,111</b>	<b>55.4%</b>	<b>44.6%</b>

Once the data was compiled for all areas, results comparing the relative ages of observed litterers confirmed existing data which shows that the most persistent litterers are between ages 15-24 and 25-34. Furthermore, the compiled data also matches other studies suggesting that people over the age of 44 and those under the age of 15 are much less likely to litter. However, it was also noted that while people under the age of 25 were most likely to litter in a group; those over the age of 25 were most likely to litter when they were alone. Although those aged 15-24 littered slightly more than other adults generally, they had lower littering rates when not in a group. Students and those currently not employed had higher than average littering rates, while those with tertiary and post-graduation educations had lower than average littering rates.

The most likely item to be littered was cigarette butts, while beverage containers were the least likely to be littered.

Table 6-2

Community Change: Age of Observed Litters - 1997							
Ages	<15	15-24	25-34	35-44	45-54	>54	All Ages
Tasmania	9	81	40	31	34	29	224
Victoria	36	68	68	68	33	21	293
Canberra	18	61	88	64	35	20	286
Sydney	5	44	80	51	34	32	245
Brisbane	23	84	87	78	32	16	320
Adelaide	18	62	48	50	27	23	229
Perth	21	80	50	50	21	14	236
Darwin	11	56	75	62	46	19	268
Total/Average	140	536	536	454	262	174	2,101
Percent	6.7%	25.5%	25.5%	21.6%	12.5%	8.3%	100.0%

Litterers gave the following reasons for their behavior:

- Laziness (35%)
- No bin nearby (19%)
- Habit & forgetfulness (14%)
- Inconvenience of keeping the waste (14%)
- No ashtray available (10%)

People who thought it was acceptable to litter in certain circumstances gave the following reasons:

- Their waste was organic
- No bins available
- At an outdoor or sporting event where waste was going to be collected

Particular focus was paid to contradictions between espoused attitudes and observed behavior. For example, most of those who littered cigarette butts considered them to be litter and felt that littering was an important issue. In addition, almost half of the people who had been observed littering within the past five minutes told interviewers that they had not littered in the last 24 hours or that they could not remember the last time that they littered.

### 6.3 Community Change – 2000

As a follow-up to its 1997 landmark study interviewing observing litterers in Australia, Community Change Consultants (CCC) examined littering behavior and attitudes from every Australian state and territory. The national observational study collected over 18,000 observations and 2,850 surveys. As in the 1997 study, observers contacted interviewers via two-way radios and described the person's appearance and location, but did not note whether they had been observed littering or binning.

Some of the littering behavior types identified by CCC include:

- Wedging – stuffing pieces of litter into gaps between seats
- Flagrant flinging – materials are thrown into the air
- Inching – people litter and then gradually move away from it
- Foul shooting – litter is thrown toward a bin, but ignored if it misses the bin
- Undertaking – litter is buried under the sand
- Clean sweeping – upon arriving at a littered table, the waste is swept onto the ground
- 90% - most trash is binned, while some is left behind
- Herd behavior – the tendency to follow the littering habits of others in a group

As in the 1997 study, attention was paid to the gender and age of litterers, which was noted by the observers. The report notes that men were slightly more likely to litter (40%) than women (about 35%). This gender breakdown is similar to the results of CCC's 1997 study.

While people of all ages were observed littering, the littering rates dropped continuously from persons <18 to 45-54 year olds. The littering rates began to increase slightly beginning with persons 54 and older. However, for all age groups, approximately 32%-44% of each age group was observed littering.

As with the 1997 study, this study measured littering behavior by employment status. Persons not currently employed littered most frequently (about 51%) followed by students (about 44%), workers (about 39%), homemakers (about 31%) and retirees (about 27%).

The most littered items, in order, were cigarette butts (58%), plastic cups, plastic bottles, napkins and paper bags. Other than cigarette butts, specific percentages were not noted.

Litterers gave the following reasons for their behavior:

- Laziness (24%)
- No ashtray (23%)
- No bin nearby (21%)
- Habit (6%)

CCC also developed a littering behavior benchmark, the Disposal Behaviour Index (DBI), which describes the state of littering and bin use.

**Table 6-3**

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<b>DBI Level</b>	<b>Characteristics</b>
1. Low	Highly littered hot spots - urgent attention required.
2. Base	Large proportions of people littering with a base level of bin use.
3. High Base	Binning exceeds littering but action is required to raise binning levels.
4. Mid Range	Binning is twice as frequent as littering for all items.
5. High Mid	Littering still has to be addressed but most 'Do the Right Thing'.
6. High	Binning greatly exceeds littering - some refinements of bin use required.
7. Peak	Minimal littering and appropriate use of bins.

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When people who had been observed littering were queried, approximately 60% were unaware, did not remember or were unwilling to admit doing so. Those under 18 were most likely to admit they had just littered (55%) while those 55-64 were least likely to admit so (22%).



## Section 7

# MESSAGING

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One of the important aspects of this review was to establish a baseline of research that had been conducted in the more formative years of litter study. The Management and Behavioral Science Center (Wharton School of Finance and Commerce) undertook one of the earlier studies of solid waste and litter in 1970. William C. Finnie, Ph.D. wrote a paper summarizing the results of experiments that were conducted in Philadelphia, PA, St. Louis, MO, and Richmond, VA.

The first study in Philadelphia is not detailed; however, being an early study, the development of the study methodology was important. An appropriate measure would reflect the esthetic costs and the cost of collection. Finnie settled on the item count as the primary factor in collection cost and the reflection of esthetics as well, noting that a newspaper tore up into many pieces is more offensive than a whole newspaper littered. In cities, the minimum-sized item counted was a matchbook, while along highways; the minimum sized item was a cigarette pack. The logic was that items noticed while walking along a sidewalk would not be visible along a high-speed highway. This is important, as the Institute for Applied Research would echo this logic later and use it as the basis of their Visible Litter Survey methodology, which would become the industry standard for measuring litter.

The second study (Richmond) discussed tested the effect of “Peli-cans,” specially decorated litter receptacles, placed along highways. These containers were found to reduce highway litter by 28.6 percent. These reductions extended to a length of six miles. These reductions were considered to not be statistically significant due to the placement of signs preceding the litter receptacles. When replicated in an urban locale, a statistically significant 16.7 percent reduction in litter was noted when receptacles were placed on each block. When placed on every fourth block, a 6.8 percent reduction was noted, which was not considered statistically significant.

A third study was conducted in St. Louis to test the effectiveness of attractive litter receptacles compared with 55-gallon drums. Each week the attractive litter receptacles were placed along two blocks, drums were placed along two others, and no containers were placed along two others. These treatments were rotated weekly over a six-week period, so that each block had each treatment twice. The attractive receptacles reduced litter by 14.7 percent, while the drums showed an insignificant reduction of 3.2 percent. There was some speculation that lids on the drums would have increased their efficacy. These results were considered understated. If litter receptacles were known to be widely available, people might learn to hold their litter until they reached one. The effectiveness would also be expected to increase with time. Litter also may have blown from non-sampled areas onto the sampled areas.

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## Section 7

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The final experiment was designed to gauge the demographic of a litterer and circumstances in which one might be likely to litter. Hot dog vendors were observed with the following criteria considered:

1. Presence of litter receptacles
2. Cleanliness of the area
3. Gender
4. Age
5. Race
6. Apparent social status of customers (blue-collar vs. white-collar)

While litter receptacles and cleanliness of the area were considered controlled by the City, they were shown to be important factors in reducing litter (e.g., cleanliness of the area and the presence of litter receptacles were positively correlated with reduced litter). People under the age of 19 littered the most frequently. The difference in gender was insignificant, and race and social status were deemed slightly significant. The correlation to race may have been spuriously correlated with income level and not attributable to race.

Dr. Scott Geller has been a Professor of Psychology at Virginia Polytechnic Institute and State University (Virginia Tech) since 1979 and has conducted extensive research in behavioral community interventions for litter control. Geller addressed littering as a behavioral problem at its heart, noting that items are considered litter when found in a “socially unacceptable location.”

Geller also referenced a litter survey conducted by Public Opinion Surveys, Inc. for KAB in 1968, which concluded that:

- Twice as many males litter as females;
- Adults aged 21-35 are three times as likely to litter as those over 50;
- Adults aged 21-35 are two times as likely to litter as those 35-49;
- Rural residents are more likely to litter than residents of large cities; and
- Individuals from small households (1-2) are less likely to litter than those from large households (5+).

Geller noted that this data was derived from interviews rather than observed behavior. He notes the potential disconnect between verbal statements and actual behavior and concludes that younger males are more likely to admit to having littered. Geller further speculated that everyone is a potential litterer in certain situations and the key is to alter situations. He observed that, ironically, younger persons are actually the most useful participants in antilitter programs.

He evaluated the KAB's Photometric Index for measuring litter reduction and noted its potential, offering guidelines that would make the data more meaningful such as conducting a second set of photometric indexes after a fixed period to reflect the distinction between accumulated litter and recently generated litter.

Geller addressed behavioral strategies for litter control, noting the importance of increasing trash can availability, using beautified receptacles, the existence of environmental litter, and displaying antilitter messages. He concluded that effective litter prevention is a function of specificity and convenience. He also noted that when messages become so specific that they threaten individual freedom, they may elicit rebellion and result in decreased compliance. He observed that consequence strategies have a transient effect and that the greatest gap in litter control research conducted to date has been the failure to study long-term effects of anti-litter strategies. Topics he discussed included:

- Antecedent instructions as antilitter prompts
- Attempts to prompt litter pickup
- Response priming and psychological reactance
- Environmental litter as antecedent
- Trash receptacles as antecedent strategies
- Modeling as an antecedent strategy
- Consequence strategies for litter control

Geller evaluated the KAB “Clean Community System” as developed in 1977. He praised the program as one with great potential, particularly the organizational structure. He noted how the evaluation procedures may be subject to experimenter bias and risky interpretation and suggests spending less time interviewing citizens and more time making reliable observations of environment-behavior relationships.

Silverzweig Associates conducted an assessment of the behavioral foundations of the Keep America Beautiful System in 1986. Original KAB research noted that littering is a behavioral issue, that it is quantifiable and was an issue that communities could be motivated to resolve. KAB had identified 3 negative littering norms, noting that people litter where:

- 1). They feel no ownership;
- 2). Someone else will clean up after them; and
- 3). Where trash has already accumulated.

KAB also identified 3 positive norms:

- 1). Correlating individual behavior with a clean community;
- 2). Individual’s accepting ownership of a community’s public places; and
- 3). Expecting community leadership to accept a role in community change.

This assessment noted average litter reductions of 32 percent within the first year and 80 percent after five years using KAB’s Photometric Index. A cost/benefit analysis conducted by the American Public Works Association concluded that the KAB system yielded four major areas of financial benefit:

1. Cost reduction and cost avoidance, including a savings of \$500,000 in a mid-size community’s street sweeping budget.



## Section 7

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2. Cash and in-kind contributions of up to \$2.5 million in a single community. Total dollars leveraged by KAB nationally was \$70,000,000.
3. Volunteer hours including workshops, litter prevention programs and meetings reached as high as 129,557 hours in a single community and were worth \$434,037 calculated at minimum wage.
4. Intangible benefits such as the increased ability to attract new businesses and increase tourism and convention revenue.

Social psychological research and its applications to developing effective anti-litter public service announcements (PSAs) were reviewed. Renee Bator referred to the work of several authors to address creating a more comprehensive approach to crafting more useful anti-litter messages.

Bator refers to three primary tools:

1. McGuire's input-output matrix
2. Atkin and Freimuth's step-by-step guide
3. Petty and Cacioppo's model of attitude change.

McGuire's matrix considered two sets of variables. The input or communication variables include source factors, which identify the demographics of the target audience. The first consideration identifies the target audience based on their personal norms regarding littering, their exposure to media channels, demographic data and physical locations in common. The spokesperson chosen should match these demographics. PSAs should be conducted in an environment that is familiar to the audience.

Other factors Bator mentions include aspects of the message (delivery style, length and exposure); channel (which mode of media to use), receiver and destination. This final step in the input portion of the matrix considers the specific goal of the message. In this case, she suggests that the goal of anti-littering PSAs is to stop an existing behavior pattern, replace it with a new habit, thereby producing long-term change.

McGuire's output variables include 12 response steps that should be considered for the PSA to successfully communicate the message intended. The public must be exposed to the message, persuaded to listen, become interested, understand it, learn how to behave differently, agree with the message, store it and be able to retrieve it when exposed to the appropriate situation, be able to make a good decision based on this information, act accordingly, attain reinforcement, and talk to others about this new learned behavior.

Bator notes that McGuire's matrix is most valuable in the message design phase. She also notes that choosing a message that people like does not necessarily equate with a message that will get people to change their behavior.

Secondly, Bator discusses the value of Atkin and Freimuth's step-by-step guide, which includes the preproduction stage and the production testing phase as a tool for developing a strong campaign. Preproduction involves the selection of the target audience, while production testing evaluates reactions to the message while it is still in the formative stage.

In the preproduction stage, Bator suggest using a “Personal Norm Against Littering” survey created by Cialdini, Kallgren and Reno, which measures a person’s sense of obligation to not litter in different situations. Those respondents with the weakest norm are considered the best targets for intervention if they are considered open to changing this behavior.

In a discussion of social norms, Bator suggests that a problem with the Iron Eyes Cody spot was that it provided messages that were contradictory. The descriptive norm describes how others generally behave in a given situation. In this case, the descriptive norm was littering. The injunctive norm describes what behavior is generally approved in a given situation. In this case, Cody was the one party disapproving of littering.

Bator states that an improved version of that spot would clarify the message. It would show only one person throwing a bag of litter at Cody’s feet in an otherwise clean area, showing a descriptive norm that most people do not litter. She then suggested that several parties disapprove of the littering, which would strengthen the injunctive norm – that littering is not acceptable behavior. Bator also noted that Cialdini et al. had found that social disapproval of littering was a strong motivator even when litter is shown in heavily littered areas.

Similarly, two compiled Disney videos addressing litter in 1957 and 1961 showed one character lecturing his audience about littering issues. Once the talk was finished, the lecturer tore up his notes and threw them on the sidewalk until a second character showed disapproval. Thus, the Disney videos also showed a descriptive norm of littering with an injunctive norm against littering.

Wesley Schultz, Ph.D., has addressed this issue as well. No academic articles were found by Wes Schultz on the specific topic of litter, although a PowerPoint presentation of his indicated that he supported this viewpoint on social norms related to littering. One slide showed two jars asking for tips. One was empty while the other was full. Schultz asked rhetorically which one would attract more tips. Schultz’s view of the importance of the descriptive norm is in sync with Bator’s view.

Bator goes on to discuss the fact that consumer decisions that are not made during an advertisement depend on message recall, referencing the ad campaign for LIFE cereal and its “Mikey” commercial. By using a picture from the ad on the cereal box, consumers were able to relate this product to the commercial. She noted that the long life of the ad spoke to its efficacy. Use of this encoding and retrieval mechanism has been used in anti-littering PSAs successfully.

Once consumers decide to adopt a new behavior pattern, they usually adopt an identity consistent with that behavior. For example, signing a written commitment helps internalize their commitment. Carrying that forward, the purchase of bumper stickers or T-shirts will help support the campaign and spread the message to others. Collecting reactions from the target audience through the use of focus groups can help ensure that the message resonates with the audience.

Petty and Cacioppo developed an elaboration likelihood model that evaluates how much mental processing occurs with the target audience. Petty, et al. identified central and peripheral processing. Central processing occurs when the audience is motivation

## Section 7

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and takes time to consider the message. Peripheral processing occurs when the target's ability or motivation to consider the message is low. Bator notes that peripheral processing rarely produces permanent behavioral change, while central processing is more likely to result in eliciting the desired behavior.

The choice of slogans was addressed by an IAR report (Targeting Advertising Programs) and concluded that tough slogans such as "Don't Mess with Texas" and "Don't Mess Around" (Bermuda) tended to succeed and continue more than ten years compared with slogans such as "We're Having a Neat Wave" (Florida) and "Don't Waste Our State" (Minnesota) that were terminated within two years.

Two slogans more recently adopted that are also strong in tone include Washington State's "Litter and It Will Hurt", which reduced litter by 24 percent between 2000 and 2004, and Georgia's new slogan "Litter. It Costs You", which was adopted in 2006. Both slogans have been accompanied by significant support from enforcement officers and the court system along with supportive PSAs.

## Section 8

# CIGARETTE BUTT LITTER

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### 8.1 Introduction

According to the Center for Disease Control and Prevention (CDC), 44.5 million U.S. adults were considered smokers in 2004. This equated to 21 percent of all adults (23.4 percent of men, and 18.5 percent of women), or more than one of out every five adults. At the same time, the U.S. Department of Agriculture estimated that 388 billion cigarettes were consumed in the United States during that same year. Table 8-1 provides a breakout of the number of cigarettes consumed by year in the United States from 1993 thru 1996.

Table 8-1  
Annual Cigarettes Consumed in U.S.

Year	Cigarettes Consumed (Billions)
1993	485
1996	487
1999	435
2001	425
2004	388
2005	376
2006	371

Source: U.S. Department of Agriculture

A March 9, 2006 article in the Washington Post titled “Smoking in U.S. Declines Sharply,” states that information provided by The American Legacy Foundation indicates that Americans smoked fewer cigarettes in 2005 than at any time since 1951. This trend, shown in Table 8-1, seems to be continuing. The decline may be a result of the higher costs of cigarettes (largely due to taxes), restrictions on advertising, and a shift in public perception of the risks involved with smoking. With all the data pointing towards a decline in the number of cigarettes being smoked, three questions arise: (1) Do cigarette butts pose a litter problem? (2) If so, how significant of a litter problem are cigarette butts? and (3) What is the effect of smoking bans in the workplace and other public areas on cigarette butt litter?



## 8.2 Cigarette Butts as a Source of Litter

Multiple litter studies have shown that when counting litter on a per-item basis, cigarette butts comprise the number one littered item on our roadways and in our waterways. During the 2005 Texas Litter Study performed by Nu-Stats, cigarette butts comprised 28 percent of all visible litter. The Texas Department of Transportation estimates that more than 130 million cigarette butts accumulate on Texas highways every year. In the 2002 Florida Litter Study conducted by the Florida Center for Solid and Hazardous Waste Management, cigarette butts were found to have comprised 26 percent of all “small item” litter. In 2001 cigarette butts comprised 25 percent of all small-item litter, and between 1997 and 2000, cigarette butt litter comprised an average of 27 percent of small items.

During the 2001 Iowa study conducted by Barker Lemar Engineering Consultants, tobacco-related products were found to comprise 37 percent of all litter. While in a 1989 New Jersey study cigarette butts were over 23 percent of the total litter found on roadways and other locales. Other litter surveys have also shown that cigarette butts have continued to constitute a significant portion of total litter: Washington (2000) estimated that 260,000,000 cigarette butts are littered on their roadways each year. A 2002 Toronto litter survey noted that cigarette butts comprise 22.5 percent of litter less than four inches square in size. Nebraska noted that tobacco products, including cigarette butts, constituted 26 percent of litter – the highest of any category.

In 2006 R. W. Beck conducted visible litter studies for the states of Georgia and Tennessee. Although the study counted items one inch or greater (thus excluding cigarette butts), the field crews performed a sub-sort of cigarette butts at the beginning of the edge count, which measures litter on the roadside beginning at the edge and measuring three feet inward and normally 500 feet in length.

Results showed that in Georgia a total of 5,347 items of litter were counted on the edge of roadsides during the survey. The extrapolation of the edge counts for cigarette butts in Georgia yielded an estimate of 42,912 cigarette butts, slightly more than eight times the amount of all other litter items combined on the roadway edges in Georgia. In an unpublished Tennessee survey, the results were even more pronounced. A total of 3,661 items of litter were counted on the edge of roadways during the survey, while the extrapolated number of cigarette butts was an estimate of 76,561, more than 20 times the amount of all other litter items combined on the roadway edges.

These results may be due in part to the fact that some area cleanups bypass cigarette butts and only collect larger litter items. Cigarette butt litter that originates on our nation’s streets and roadways may end up being deposited into our streams, rivers and beaches during periods of rain or high-tide. Studies on the amount of cigarette butt litter on our waterways have been performed by the Ocean Conservancy and other organizations.

Studies performed annually by the Ocean Conservancy during the International Coastal Cleanup (ICC) event draw more than 300,000 volunteers around the world who collect debris from beaches, rivers and streams. Results of the ICC showed that every year cigarette butts topped the list as the most abundant item collected world

wide. Although data exists from 1998 thru 2004 on the total number of cigarette butts collected world-wide, only 2003 and 2004 data show cigarettes as a percent of U.S. debris. In 2003 cigarette filters, tips, and tobacco packaging accounted for 38 percent of the U.S. debris, while in 2004 the number had dropped to 29.6 percent of U.S. debris. According to the Surfrider Foundation, during the 2000 Coastal Cleanup Day, 230,000 cigarette butts were collected on California beaches and accounted for the number one trash item found. Additional studies performed in the coming years by litter studies and organizations such as the Ocean Conservancy should provide key data as to whether cigarette butt litter is decreasing as the number of cigarettes sold in the U.S. decline.

### 8.3 Workplace Smoking Bans

According to Clean Virginia Waterways, many states and local communities are adopting workplace smoking bans. As of Election Day 2006, 18 states and the District of Columbia had passed or voters had approved indoor smoking bans. What impact have these bans had on the concentration of cigarette litter? Clean Virginia Waterways states that the recent bans on indoor smoking have appeared to cause a shift in cigarette butt deposition. Circumstantial evidence indicates that more cigarette butts are accumulating outside of buildings due to the increase of indoor smoking bans.

In Australia, cigarette butts account for 50 percent of all litter, a trend that the executive director of Keep Australia Clean blames partly on indoor no-smoking policies. Ireland and Scotland are seeing more cigarette litter due to their bans on indoor smoking. According to tobacco.org, the City of Wilmington, NC is planning on installing 25 30" x 3" ash trays along their main bar and shopping district in an attempt to keep pedestrians from littering their cigarette butts. Susi Hamilton, the director of Wilmington Downtown, was quoted as saying "With more and more buildings becoming smoke-free, it's important that smokers retreating outside have easy access to ashtrays or the problem will only worsen."

As smoking bans continue to occur across the United States, it will be important for businesses and/or the state or local governments to provide proper receptacles and signage to keep cigarette butts from becoming such a persistent category of litter.

The costs to cleanup cigarette butt litter can be substantial. Penn State spokesperson Paul Ruskin noted, in April 2007, that Penn State spends \$150,000 each year to clean up cigarette butts and other cigarette litter on campus.



## Section 9

# EFFECTIVENESS OF LITTER RECEPTACLES

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In a study evaluating the effectiveness of litter receptacles as an antecedent strategy, William Finnie found that conspicuously decorated trash receptacles on highways reduced litter by 28.6 percent and that these reductions were apparent six miles from the receptacles, although signage preceding the receptacles did not significantly influence littering rates. Finnie replicated similar results in several subsequent studies. O'Neill (1980) was able to produce similar results using a novel receptacle that lifted the top of a hat with the word "thanks" appearing. When Geller tried to reproduce these results, he noted that litter rates were lower in the area surrounding the decorated receptacles, but were actually higher in the areas most remote from the decorated receptacles (Geller, 1980).

Between 1971 and 1983, the Institute for Applied Research (IAR) evaluated the effectiveness of receptacles in reducing litter in six states (Alaska, California, Hawaii, Mississippi, Nebraska and Washington) and two cities (Philadelphia, PA and Richmond, VA). IAR concluded that litter receptacles were effective in reducing litter, averaging 40 percent lower rates in both urban and rural locales (IAR). Table 9-1 below provides detail regarding the effectiveness of the litter control receptacles by City/State.



## Section 9

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Table 9-1  
Effectiveness of Litter Control Receptacles

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Location	Year	Locale	Type Of Comparison	Number of Sites	Percent Reduction
Richmond, VA	1971	Rural Highway (mostly limited access)	Side by Side	18	28.6%
Richmond, VA	1971	Urban City Streets (Comm, Res)	Side by Side	2	16.7%
Philadelphia, PA	1971	Downtown Commercial Streets	Side by Side	2	55.9%
California	1974	Recreation Areas (Mostly Urban)	Side by Side	82	41.8%
Mississippi	1977	Rural State Highway	Side by Side	1	52.0%
Nebraska	1980	Urban Commercial Streets	Side by Side	12	41.4%
Hawaii	1981	Urban Commercial Streets	Side by Side	10	46.3%
Alaska	1981	Urban Commercial Streets	Side by Side	10	57.0%
Washington	1982	Urban Commercial Streets	Side by Side	16	27.5%
Alaska	1981-83	Urban Commercial Streets	Before & After	10	36.6%
<b>Total</b>				<b>163</b>	<b>40.4%</b>

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## 9.1 Case Study – City of Long Beach, CA

Properly placed litter receptacles in areas such as commercial zones and public places (parks, beaches, etc.) can have a positive effect on the amount of litter in that general vicinity. Many cities implement various programs to control the discharge of litter and other pollutants into their public areas. Long Beach, California has implemented a program to reduce the amount of trash and litter from entering the City's receiving waters (via storm-water runoff). One portion of this plan involves the placement of receptacles, used for the control of litter and refuse, in business areas, at bus stops, in parks, in marinas, and along beachfronts. According to the city of Long Beach's Storm Water Management Program Manual, the City's Environmental Services Bureau has approximately 1,000 litter receptacles along public street frontage. Every receptacle is serviced at least weekly. The city also encourages businesses to place additional litter receptacles in major retail areas. In addition to public street frontages, the city placed approximately 2,100 litter receptacles along the beach front, in parks, and in the marina area. The receptacles are serviced by the Maintenance and Development Bureau ranging from twice per week during the winter season, to twice per day during the summer months (Long Beach).

The city's Environmental Services Bureau uses field supervisors and refuse investigators to ensure that the litter control receptacles do not overflow. Disposal patterns are tracked so that the Refuse Division can properly size receptacles for weekly services. In the event that a field supervisor notes the need for a larger receptacle, or damage repair, corrective action is immediately taken. The City surmises that their litter receptacles prevent refuse that otherwise would have ended up in the storm drain system. The program manual states that "In 1996, 450 receptacles placed on residential and commercial streets collected over 290 tons of trash. The methods for assessing this program include estimating how much refuse is collected from litter receptacles and visually evaluating areas around several litter receptacles for cleanliness."

## 9.2 Concerns Associated with, and Management of, Litter Receptacles

Most of the concerns associated with litter receptacles arise not from the receptacle itself, but from improper maintenance or lax enforcement of laws related to the use of such receptacles. An overflowing litter receptacle, such as at a park or bus stop, becomes not a litter prevention tool, but instead ends up contributing to the litter problem. As the receptacle fills up, people are still inclined to rest trash and litter on-top of the container. Once this occurs, rain, wind, and even gravity can cause the items to fall out and disperse, thus exacerbating the problem.

There are many ways to help ensure that litter receptacles are properly used and maintained. First and foremost, laws must exist requiring the proper use of the receptacle. For instance, The National Center for Environmental Decision Making Research (NCEDR) developed a decision maker's guide to controlling litter and illegal

dumping. The guide in-part reports on state laws that prevent litter and illegal dumping, including the requirement of litter receptacles to be properly maintained and used.

The NCEDR guide states that a Missouri Division of Tourism report on litter control in state tourist areas noted the potential hazards posed by litter receptacles. The report said in part, “For example, vandalism may necessitate chaining litter receptacles to an anchor. Fires may be ignited in a remote or unsupervised litter receptacle. In addition to travel litter, household trash may be placed in the litter receptacle.” Unfortunately, R.W. Beck was not able to obtain a copy of this report for further analysis.

In Louisiana, laws exist that require that litter be placed into a receptacle “in such a manner that the litter will be prevented from being carried away or deposited by the elements.” Violators can be fined a maximum of \$50. Aside from proper litter receptacle use, NCEDR reports that several states prohibit the disposal of garbage generated off-site into public litter receptacles. For example, “Illinois prohibits the disposal of garbage, from a residence, business, or other site, at trash barrels or receptacles located on public highways or rest areas” (NCEDR).

Using state employees is the most common way that litter receptacles are emptied and maintained. However, working with private property owners and businesses is another way to maximize the effectiveness of litter control agents. As properly maintaining and emptying trash and litter receptacles can be time-consuming and expensive, a partnership between the public and private sectors can alleviate the costs of such upkeep. According to the NCEDR, “one example of a public/private litter receptacle partnership is offered by Keep Austin Beautiful. The advertising rate paid by the private, sponsoring partner covers the cost of the receptacle. A sticker with the sponsor's name is placed on the receptacle. Sponsorships are for a five year term.”

In a report on littering behaviour in Australia (BIEC), no statistical differences in ages or gender were noted for those who used litter receptacles. Both the BIEC report and IAR studies suggested that littering was a group activity for those who were under age 25. IAR concluded that 69 percent of all deliberate litterers were in a group when 288 littering incidents were observed. The BIEC report, which recorded 8,968 observations, went on to suggest that people aged 15-24 had lower littering rates than other adults when they were alone. Both the BIEC report and a Walt Disney video on littering (1962) indicate that secretly hiding litter in bushes, etc. was a regular practice for certain litterers as well as noting a “sports” litterer who tries to shoot hoops with their litter without regard to their accuracy.

### 9.3 Conclusion

Aside from the BIEC and IAR studies, little statistical data exists showing the ability of litter receptacles to control litter. The data that does exist suggests that proper maintenance and location of litter receptacles are important tools in helping to reduce litter. More comprehensive research should be conducted in residential, commercial, and public areas to determine how to improve the effectiveness of litter receptacles in reducing litter.

## Section 10 COSTS OF LITTER

Scott Geller made reference to the following litter statistics from studies conducted between 1970 and 1975:

- Amount of litter found on our nation's highways - 4 billion tons/year;
- Costs to deal with it - \$1 billion/year;
- Average cost per state - \$1 million/year;
- Injuries from vehicle accidents related to litter: 500 - 1,000 per year; and
- Every 12 minutes a home is damaged or destroyed by fire starting in rubbish/litter.

A 1999 study by the Florida Center for Solid and Hazardous Waste Management (FCSHWM) researched the economic impacts of litter on businesses. As shown in Table 10-1, a total of 180 businesses spent an average amount of \$2,434.73 for litter cleanups. These costs may understate total costs, as they may exclude some costs that are associated with litter cleanups, such as property maintenance, landscaping costs and solid waste collection services.

Table 10-1  
Average Cost of Litter Cleanups in Florida Communities (1999)

City	Avg. Annual Cost	# of Businesses	Total Cost
Brevard MSA	\$1,950.00	18	\$35,100.00
Fort Lauderdale	\$1,916.47	19	\$36,412.93
Hollywood	\$2,492.17	19	\$47,351.23
Jacksonville	\$849.75	16	\$13,596.00
Miami	\$3,535.24	17	\$60,099.08
Orlando	\$1,702.01	17	\$28,934.17
Tallahassee	\$2,244.87	17	\$38,162.79
Tampa	\$2,358.20	18	\$42,447.60
West Palm Beach	\$3,119.37	19	\$59,268.03
St. Petersburg	\$3,843.84	20	\$76,876.80



## Section 10

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This study, conducted by FCSHWM, showed that the cost for businesses to manage litter is significant and that extrapolating these results to the total number of businesses in Florida suggests that Florida businesses pay more to deal with litter than the state spends.

Vancouver-Clark Parks and Recreation in the State of Washington reported in March 2007 that the cost for collecting litter at county parks in 2006 was \$68,000, a number close to Iowa's cost of \$76,000 for handling litter in their national parks (Table 10-2).

Another study conducted for the State of Iowa by Franklin Associates (Table 10-2) showed the litter management costs for cities, counties and other private and public entities. This survey suggests that the costs to cities and counties easily exceed the states' DOT costs to collect litter. The school districts in Iowa spend almost twice the amount that the Iowa DOT spends to handle litter.

**Table 10-2**  
**Summary of Iowa Litter Management Costs (2001)**

Iowa 2001 Litter Study – Summary of Entities Surveyed	
Entity Name	Estimated Annual Costs
School Districts	\$3,336,000
Cities	
▪ Population under 1,000	\$370,400
▪ Population b/w 1,000 & 10,000	\$1,282,700
▪ Population over 10,000	\$2,117,900
Counties	\$2,194,700
SW Planning Area Roads, Ditches, and Fence Lines	\$321,900
Universities	\$295,700
State Conservation Officers	\$24,000
State Historical Society	\$65,900
Iowa State Fair	\$9,100
State Parks and Preserves	\$1,001,400
State Forests	\$8,400
Wildlife Bureau Division	\$80,500
National Guard Armories	\$124,000
Iowa Dept. of Transportation	\$1,842,700
Iowa Highway Patrol	\$76,900
Corps of Engineers	\$171,700
National Fish and Wildlife Refuges	\$78,800
National Parks	\$76,000
<b>State Total:</b>	<b>\$13,478,700</b>

Rural and Urban Roads magazine (RUR) conducted litter cost surveys between 1972 and 1975 with data obtained from each state's transportation department. The average of those costs was compared to a survey conducted by the National Cooperative Highway Research Program in 1991-92 (Table 10-3). While both surveys focused on the state costs, in 1973 RUR conducted a limited survey of county costs as well. A stratified sample of 15 counties yielded a total cost of \$1,038,000 or an average of \$69,200 per county. Extrapolated for the 2,700 counties, the cost to counties in 1973 would have been \$186,840,000 nationally. These survey results support those of the Iowa report (Franklin) showing again that counties and cities are each likely spending more than the states to clean up litter. In a 2007 news article, Bartlett, TN revealed that their cost for litter cleanup has reached \$100,000.00 annually.

RUR sampled eight counties and eight toll ways in 1974 and found that toll ways pay about \$442 per mile for litter cleanup, while the counties sampled were paying about \$110 per mile for litter cleanup.

Section 10

Table 10-3  
Summary of State Highway Litter Cost Survey Results

State Highway Department Costs: Litter Cleanup			State Highway Department Costs: Litter Cleanup		
States	Avg. (72-75)	1991	States	Avg. (72-75)	1991
California	\$7,354,597	\$28,000,000	Oregon	\$577,500	\$480,000
Texas	\$3,517,500	\$12,000,000	Minnesota	\$676,854	\$2,000,000
Illinois	\$2,175,000	\$6,300,000	Oklahoma	\$421,239	\$3,587,000
New York	\$2,756,750	\$6,000,000	Iowa	\$395,613	\$730,000
North Carolina	\$2,431,948	\$1,200,000	Mississippi	\$409,362	\$920,000
Pennsylvania	\$1,677,680	\$5,000,000	Alabama	\$710,865	\$1,168,000
Georgia	\$1,890,000	\$3,590,000	Arizona	\$449,624	\$1,500,000
Kentucky	\$1,527,792	\$3,500,000	Utah	\$317,716	\$837,000
West Virginia	\$1,469,477	\$2,000,000	New Mexico	\$461,527	n/a
Tennessee	\$1,417,267	\$1,300,000	Maine	\$278,103	n/a
Florida	\$1,673,750	\$6,500,000	Nevada	\$396,650	\$1,646,000
Connecticut	\$1,132,164	\$1,700,000	Arkansas	\$216,542	\$1,152,000
Massachusetts	\$1,273,170	\$860,000	Kansas	\$250,000	\$344,000
New Jersey	\$593,542	\$5,500,000	Idaho	\$250,086	\$500,000
Virginia	\$1,141,152	\$3,000,000	Nebraska	\$275,731	n/a
Michigan	\$1,439,750	\$2,700,000	New Hampshire	\$291,250	\$1,000,000
Indiana	\$953,138	\$1,722,000	Hawaii	\$207,397	n/a
Wisconsin	\$1,058,369	n/a	Vermont	\$205,006	\$650,000
Washington	\$832,088	\$1,500,000	Delaware	\$199,834	\$322,000
South Carolina	\$712,500	\$1,400,000	Montana	\$248,024	n/a
Ohio	\$967,444	\$2,870,000	Wyoming	\$184,900	\$1,200,000
Louisiana	\$749,675	\$400,000	Alaska	\$117,500	\$200,000
Colorado	\$737,500	\$3,252,000	South Dakota	\$175,425	\$200,000
Missouri	\$611,620	n/a	North Dakota	\$62,298	n/a
Maryland	\$519,194	\$400,000	Rhode Island	\$124,226	n/a

Source: Rural and Urban Roads Magazine (1973-1976)

## Section 11

# ENFORCEMENT

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One of the continuing issues of littering has been the perceived lack of interest by both enforcement officials and the reluctance of the courts to impose convictions for these offenses.

In 1971, the International Association of Chiefs of Police surveyed 2,574 police departments representing all regions and levels of government. From this survey, 1,035 completed surveys were returned. About 75 percent of those surveyed had issued an average (mean<sup>1</sup>) of 32 tickets during the survey year (1970), while 14.1 percent stated that their departments had made no litter-related arrests. The remaining 11.7 percent were uncertain. Municipal police accounted for 83.9 percent of the arrests, while all other entities accounted for the remaining 16.1 percent of arrests.

About 72.1 percent of the departments surveyed reported an average of 25 convictions. Another 12.3 percent reported no convictions, while the remaining departments were uncertain. In what was then seen as a new approach to litter punishment, clean-up sentences were used by 27.5 percent of the departments surveyed. Departments across the country agreed that the reason for limited arrests was the difficulty in catching litterers (46 percent), while 9.8 percent attributed the limited arrests to the difficulty in convicting litter cases in court. Only 12.3 percent said the limited litter arrests were because litter was not as important as their other duties.

An overwhelming 86 percent of departments felt that public education was necessary for improved enforcement, which included educating all enforcement agencies and the courts on the seriousness of these offenses. Increased public education and cleanup sentences were the most recommended improvements.

A 1999 Florida study of businesses found that 76 percent of respondents thought litter laws were ineffective because they are not enforced and there is very little awareness of these laws. Twenty-three percent believed these laws were somewhat effective, but only 1 percent believed these laws were very effective. Of these one hundred ninety businesses, 98 percent believe that litter lowers property values and has a negative effect on their business. Seventy-eight percent thought that there was a connection between litter and crime.

Geller, evaluating the efficacy of litter-control programs, warned of “behavioral reactance,” overt defiance of the behavior desired. This resulted from studies conducted by Geller and his students to note the response to various messages and prompts. The findings noted that demand prompts resulted in higher litter rates than

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<sup>1</sup> The study itself reported a median value of approximately 8, while the calculated mean was about 32.

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specifically encouraging prompts. This calls into question the efficacy of threatening roadway signs when the perception is that enforcement is lax to begin with.

George Kelling, in an article first published in *Atlantic Monthly* in 1982, proposed a “broken windows” theory, which suggested that neglecting small problems, such as a single broken window, can suggest that the descriptive norm is neglect, which tends to empower vandals and squatters. The theory suggests that these small untended problems (including litter) can lead to a negative feedback loop eventually resulting in a rise in crime and an atmosphere of fear in a neighborhood. Cities such as Cincinnati and New York have claimed successful crime reduction based on implementations of this theory. Detractors note other reasons for these successes and that focusing enforcement officials’ time on petty crime takes away needed time for more serious issues.

One of the most innovative approaches to improved enforcement has been the establishment in Memphis, Tennessee of the nation’s third environmental court, which was designed to hear all cases of an environmental nature. The new court used an existing municipal court without additional costs to taxpayers. Judge Larry Potter presided over these cases and became a judge who specialized in environmental laws and regulations. Inspector morale was raised by use of a streamlined approach which did not tie them up inordinately. Inspectors became better versed with environmental laws and began to understand the most effective ways to frame their cases. The system heard and acted on cases swiftly, which encouraged neighborhood groups as well as civic and political leaders. The U.S. Conference of Mayors Conference on Building Clean, Livable Cities (1999) noted that to date there were about 70 similar environmental courts across the U.S., patterned on the Memphis County model.

## Section 12

# OTHER LITTER-RELATED ISSUES

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Robert Healy, Professor of Environmental Policy in the School of the Environment at Duke University, conducted research on the effects of overused landscapes on tourism and economic development. He references Garrett Hardin's "Tragedy of the Commons," in which a common grazing area is available to all residents, but that no resident realizes the value of avoiding overuse, resulting in the tendency to overuse resources. These resources are subject to two types of overuse: congestion and damage. Healy considers littering as a type of resource damage. The more degraded a tourist element becomes, the less tourists will choose to spend time there, thereby causing an economic loss associated with this resource damage. He notes that private involvement in the maintenance of these resources can result in a higher quality of landscapes. Healy particularly notes the problems associated with government management of public resources – the lack of political will to manage overuse and the lack of funding, particularly related to user charges.

The Florida Center for Solid and Hazardous Waste Management noted the link between litter and the health of Florida's tourism in a 1999 study ("The Economic Impacts of Litter on Florida's Businesses"), stating that "maintaining an attractive environment is a critical element of sustainable economic prosperity".

The Silverzweig Associates assessment of the KAB System noted that there are unquantified benefits to litter reduction, such as the improved ability to attract new businesses and increases in revenue from tourism and convention.



## Section 13

# RESEARCH GAPS

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R. W. Beck identified the following gaps in the literature, which might be suitable for future study, and could result in additional tools and strategies for further understanding and reducing litter.

1. Create a standardized attitudinal study template. This will allow for more comparability between states and make it possible to ultimately develop a national database.
2. Develop a standardized litter survey methodology that would correlate item counts of litter with the visual surveys conducted by KAB affiliates. This will allow for better comparability between states and make it possible to combine results into a national database.
3. Create a standardized litter hotline form that can track meaningful data such as type of vehicle, gender, and estimated age bracket of litterer.
4. Create a template for educational campaigns focused on recruiting support from the enforcement and judicial communities.
5. Survey litter costs incurred by states, counties, cities and certain private entities such as universities and businesses to help determine the true costs of littering to our national economy.
6. Conduct follow-up of the 1971 survey of law enforcement departments across the country, expanding it to include the courts.
7. Determine the costs of litter to the tourism industry and to economic development efforts by the states.
8. Revisit litter enforcement-related ordinances for effectiveness. For example, some ordinances mandate fines for depositing fast-food litter in municipal receptacles or receptacles located at service stations. Ordinances such as this work counter to litter-reduction goals.
9. Conduct research using large sample sizes and a variety of different venues to better determine the role of gender, age and other demographic factors (e.g. rural vs. urban settings) in littering.
10. Conduct additional research on the effectiveness of litter receptacles and on the effects of poor maintenance of litter receptacles on litter rates.
11. Determine how to structure messaging more effectively using appropriate descriptive and injunctive norms.



## Section 13

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12. Determine the correlation between enforcement and litter reduction and the correlation between levels of fines and litter reduction.
13. Conduct research to specifically identify the sources of unintentional litter.
14. Conduct research to specifically identify the sources of intentional litter.

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## Section 14

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# APPENDIX

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Table A-1  
IAR-Based VLS Surveys

State	VLS		Top Five Sources of Litter (by percent)					Accidental vs. Deliberate	Visible Litter Items per mile <sup>1</sup> KAB vs. Non-KAB	Visible Litter Items per mile <sup>1</sup> AaH vs. Non-AaH	Key Findings	Discrepancies
	Year Performed	Sites Sampled	1	2	3	4	5					
	Tennessee	2006	95	Misc. Plastic - 21.1%	Misc. Paper - 18.0%	Vehicle Debris and Packaging - 14.4%	Candy, gum, snack wrappers - 9.7%					
Georgia	2006	96	Misc. Plastic - 22.3%	Misc. Paper - 18.6%	Candy, gum, snack wrappers - 9.4%	Vehicle Debris and Packaging - 9.1%	Misc. metal and foil - 8.2%	34% deliberate vs. 66% accidental	N/A	300 vs. 900 (COM only)	1. Edge count total = 5,347 items. Meander count = 16,520. 2. 26.8% of litter exposure likely to occur on RES roads. 3. 26.7% of litter exposure likely to occur on UFT's. 4. 0.7% of litter exposure likely to occur on OSR's. 5. KAB Litter Index utilized - avg. score of 2.8. 6. UFT's have the highest number of visible items/mile of any locale type with with an average of slightly over 5,000.	Visual only
New Jersey	2004	94	Misc. paper - 12.9%	Snack food packaging - 9.3%	Cups, Lids, Straws - 8.9%	Misc. plastic - 7.7%	Napkins, bags, tissues - 6.9%	55% deliberate vs. 45% accidental	N/A	N/A (only 2 active sites, no conclusions drawn)	1. 60% of all deliberate litter on freeways & rural roadways done by 11-34 year olds. 2. 75% of all deliberate litter on urban streets done by 6-24 year olds. 3. Adopted sites b/w 9 and 15% cleaner than non-adopted. 4. Majority of litter found in OSR, then VIU, then RFT. 5. Visible litter rate is close to the national average (1,400 items/mile) . 6. 40% of all exposure to NJ litter occurs along RES streets (as a % of time spent in locale).	Visual only
North Carolina	2001	115	Misc. paper, cartons - 16.2%	Beverage containers, caps, tabs, cartons - 15.3%	Candy, gum, snack wrappers - 14.5%	Cups, Lids, Straws - 8.6%	Vehicle Debris - 7.5%	54% deliberate vs. 46% accidental	950 vs. 1,450	1,250 vs. 1,350	1. Visible litter rates highest on RFT and OSR and lowest on RES and VIU. 2. OSR hwy's comprised the largest percentage (38) of all litter encountered. 3. PUB streets comprised the smaller percentage (6) of all litter encountered. 4. 72% of all deliberate litter done by age groups 11-34 on freeways and rural roadways (RFT, UFT, OSR, RLR) 5. 69% of all deliberate litter done by age groups 6-24 on urban streets (COM, PUB, RES, VIU)	Visual only

APPENDIX

State	Year		VLS					Accidental vs. Deliberate	Visible Litter Items per mile <sup>1</sup> KAB vs. Non-KAB	Visible Litter Items per mile <sup>1</sup> AaH vs. Non-AaH	Key Findings	Discrepancies
	Performed	Sites Sampled	Top Five Sources of Litter (by percent)									
	1	2	3	4	5							
Mississippi	2000	113	Beverage containers, caps, tabs, cartons - 17.4%	Cups, Lids, Straws - 12.63%	Candy, gum, snack wrappers - 9.4%	Misc. Paper - 9.1%	Vehicle Debris - 7.4%	62% deliberate vs. 38% accidental	1,800 vs. 2,100 (Multi-County sites)	3,600 vs. 1,900	1. 66% of all litter occurs on RFT's and OSR's. 2. Litter rates among RFT's and OSR's are 33% higher than national average. 3. UFT's and Urban streets had below average litter rates. 4. 2/3 of litter encountered by motorists and pedestrians estimated to be along RFT's and OSR's.	Visual only
Pennsylvania	1999	102	Candy, Gum, & Snack wrappers - 21%	Take out food packaging, cups, napkins - 17%	Vehicle Debris - 13%	Misc. plastic, metal & glass - 9%	Beverage containers, packaging - 8.73%	56% deliberate vs. 44% accidental	2,751 vs. 1,980 (Philadelphia Co. only)	1,582 vs. 2,969	1. Compared to US Avg. PA higher litter rates in Urban Streets, lower rates in State Hwy/Freeways and Rural Local Roads. 2. Candy, gum, snacks and take out food packaging most prevalent. 3. Beer and soft drink containers declined by 64% since 1984 study. 4. RFTs, UFTs, and OSR's account for 60% of litter that can be seen by motorists and pedestrians.	Visual only
Oklahoma	1998	106	Other Accidental (Vehicle Debris, food packaging, metal, glass, paper, wood)- 28.7%	Fast Food and Drink - 21.9%	Candy, Gum, Snack Food wrappers - 15.0%	Beverage Containers - 12.4%	Packaging Material - 7.2%	60% deliberate vs. 40% accidental	N/A	N/A	1. Highways and Rural Roads (UFT,RFT,OSR,RLR) had a weighted average of 1,923 visible items/mile. 2. Urban Streets (RES,COM,PUB,VIU) had a weighted average of 1,163 visible items/mile. 3. UFT's had the most visible items per mile of any locale at approx 4,000. 4. RLR's had the least visible items per mile of any locale at approx 4,00. 5. 22% of the total Deliberate Litter on all roadways was fast food and drink related items. 6. 28.7% of the total Accidental litter on all roadways was considered "Other Accidental" .	Visual only
Kentucky	1998	87	Candy, Gum, & Snack - 12.7%	Vehicle Debris-Supplies - 12.1%	Cups, Lids, Straws - 11.5%	Beverage Containers - 8.6%	Misc. Paper - 8.3%	56% deliberate vs. 44% accidental	1,413 vs. 1707 (Litter Reduction Programs) <sup>2</sup>	N/A	1. Highways and Rural Roads (UFT,RFT,OSR,RLR) had a weighted average of 2,060 visible items/mile. 2. Urban Streets (RES,COM,PUB,VIU) had a weighted average of 1,217 visible items/mile. 3. Cities with no litter programs (all locales) had a weighed average of 1,707 visible items/mile. 4. Cities with litter programs (all locales) had a weighed average of 1,413 visible items/mile. 5. Deliberate Litter on Highways and Rural roads comprised 49.4% of all litter. 6. Deliberate litter on Urban streets comprised 64.6% of all litter.	Visual only

State	Year		VLS					Accidental vs. Deliberate	Visible Litter Items per mile <sup>1</sup> KAB vs. Non-KAB	Visible Litter Items per mile <sup>1</sup> AaH vs. Non-AaH	Key Findings	Discrepancies
	Performed	Sites Sampled	Top Five Sources of Litter (by percent)									
	1	2	3	4	5							
Hawaii	1993	73	Candy, gum, snack - 15.1%	Napkins, Bags, Tissues - 13.41%	Beer, soft drink, liquor and wine - 12.6%	Misc. Plastic - 10.8%	Cups, Lids, Straws - 10.5%	65% Deliberate 35% Accidental	N/A	AaH < 54% Non-AaH <sup>3</sup>	1. Between 1978 and 1993 the visible litter rate for Oahu declined 75%. Between 1981 and 1993 the island of Maui experienced a 59% reduction. 2. Deposit legislation reduced bottle related litter by 90% 3. Observed 12.6 encounters of dumps and large articles of trash per 1,000 miles of driving. 4. Raw litter rates showed that RFTs and VIU's accounted for 51% of visible items per mile. 5. Conversely, raw litter rates showed that RLR's and REC sites counted for 10% of visible items per mile.	Visual only
Texas	1991	234	N/A	N/A	N/A	N/A	N/A	N/A	Only showed % reduction between sites, no comparison.	N/A	1. Litter rate along streets and highways, measured in sq. ft. of litter/mile reduced 72% since the 1985 baseline. 2. Sampling in April to minimize weed height and shredding by mowers. 3. Beverage containers declined 74%. 4. Visible items per mile decreased from 2,411 in 1985 to 720 in 1991.	1. 126 primary sites + 108 alternate sites for visible, collection, and area measurement. 2. Showed effects of wildflowers in reducing vacant lot frontage litter. 3. Calculated apparent vs. intrinsic litter rates.
Washington	1990		N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A		1. 1990 study compared litter rates in state from 1982 thru 1990. 2. Study shows fresh litter items/mile per week but no composition breakout by %.
Louisiana	1990	120	Misc. Paper - 27.1%	Cups, Lids, Straws - 11.6%	Beer, soft drink, liquor and wine - 10.2%	Candy, Gum, Snack wrappers - 9.3%	Misc. plastic - 6.8%	49% Deliberate 51% Accidental	24% lower <sup>4</sup>	N/A		1. 110 sites + 10 Louisiana Litter watch AaH sites. 2. Looked at markings on trash receptacles at service stations and food market entrances. 3. Looked at frequency of anti-litter signs and messages. 4. Looked at indiscriminate dump encounters. 5. Sites averaged over 700ft.

AVG: 112  
<sup>1</sup> Unless otherwise noted. Some numbers have been rounded  
<sup>2</sup> Performed for Louisville & Covington urban areas only. Includes AaH and other reduction efforts  
<sup>3</sup> Results based on 12 of 14 rural state highways and rural freeways on Maui and Oahu.  
<sup>4</sup> Results based on comparing 10 adopted rural state highways vs. 13 non adopted rural state highways.



APPENDIX

Table A-2  
Modified VLS Surveys

State	MODIFIED VLS			Top Five Sources of Litter (by percent)					Passive vs.	Visible Litter Items per mile <sup>2</sup> KAB vs.	Visible Litter Items per mile <sup>2</sup> AaH vs.	Key	Discrepancies
	Year Performed	Sites Sampled	Minimum Item Size	1	2	3	4	5	Deliberate	Non-KAB	Non-AaH	Findings	
	Texas	2005	136	2" or greater except all cigg butts within first 100 yds.	Cigarette Butts - 28%	Snack Wrappers - 7%	Tissue/Towel/Napkin - 5%	Beer Can - 5%	Beverage cup - 4%	N/A	N/A	N/A	
Mississippi	2004	108	4" or greater	Beverage Containers - 24%	Take out food packaging 16.8%	Misc. paper - 16.5%	Candy, gum, snack wrappers - 9.78%	Misc. plastic - 9.1%	N/A	N/A	N/A	1. Sampled 6 highway districts only. 2. Performed KAB L.I. scan at each site 3. Detailed item counts performed on 1/2 site only. 4. Avg. KAB statewide score was 1.83. 5. MS maintained highways were the most littered in volume, weight, and count.	1. Contractor (Global Strategies, Inc.) - first and only(?) litter survey. 2. Only half of sites visually sampled. 3. Small sample size (2,000 sq. ft.). 4. Retrieved items 4 inches or greater. 5. Small sample size collected (2,823 items).
Florida	2002	670	≥ 4"=Large. <4" = Small.	Large Item: Vehicle & tire debris - 14.0% Small Item: Cigarette Butts - 26%	Large Item: Construction Debris - 8.1% Small Item: Glass Pieces 16.3%	Large Item: Misc. paper - 7.5% Small Item: Paper 12.4%	Large Item: Snack packages - 5.6% Small Item: Hard plastic pieces - 11.0%	Large Item: Beer Cans - 5.1% Small Item: Plastic Film - 8.7%	N/A	N/A	N/A	1. Survey counted 30,137 large and 7,783 small items. 2. Approx. 36 large items and 6 small items per site. 3. Large litter survey covered approx. 2,832,750 sq. ft. Small litter survey covered 28,745 sq. ft. 4. Vehicle & tire debris - highest % of large litter items at 14.04%. 5. Cigarette butts - highest % of small litter items at 25.92%. 6. KAB visual litter index performed - 80% was considered Index #1.	1. 9 week sampling survey. 2. Varying width site sizes (40 feet vs. 18 feet, etc.) 3. Small linear sample size - 200 ft. 4. Large vs. small item count - no combination.
Nebraska	2001	154	No limit	Beer, Soft drink, Juice, Wine, Liquor containers - 19.2% (Accumulated Litter)	Construction Debris-Wood, etc.- 14.4% (Accumulated Litter)	Vehicle Debris-Supplies - 11.7% (Accumulated Litter)	Cartons & Carriers (paper & plastic) - 10.9% (Accumulated Litter)	Cups, Lids, Straws - 7.2% (Accumulated Litter)	N/A	N/A	Interstate - 93 vs. 45 (2,500 sq. ft.) State Hwy - 39 vs. 38 (2,500 sq.ft.)	1. Landfill roads and Interstate highways had the highest rates of accumulated litter (items & volume/mile). 2. County roads had the lowest rate of accumulated litter (items & volume/mile). 3. Urban areas - metro class cities had the highest rates of accumulated litter (34% of total) of the 5 types of areas sampled. 4. Recreational areas - had the lowest rates of accumulated litter (12% of total) of the 5 types of areas sampled.	1. Items collected and sent for sampling - this can lead to false results as in many cases not all the litter is collected. 2. Small sample sizes (2,500 sq. ft.). 3. Only 5, 189 items counted - very small sample.

State				MODIFIED VLS					Passive vs. Deliberate	Visible Litter Items per mile <sup>2</sup> KAB vs. Non-KAB	Visible Litter Items per mile <sup>2</sup> AaH vs. Non-AaH	Key Findings	Discrepancies
	Year Performed	Sites Sampled	Minimum Item Size	Top Five Sources of Litter (by percent)									
	1	2	3	4	5								
Iowa	2001	150	1/2" or greater	Tobacco products - 37%	Other plastic - 15%	Other paper - 12.8	Packaging - 11.6%	Cup related - 5.3%	N/A	N/A	N/A	1. Of the collected litter 44.8% was located along high-volume roadsides, although high volume sites accounted for only 12% of the samples. 2. A calculated extrapolation showed 1.4 million pieces of litter per mile of high volume roadsides. 3. Packaging, other paper, and other plastic made up 39.7% of all litter collected. 4. Tobacco litter made up another 37%. 5. Non-deposit beverage containers = 2.5% of all litter collected. 6. Leading brands included Marlboro, Snickers, Mountain Dew, Bud Light and McDonalds.	1. Small sample size (30' x 200') 2. Collected cigarette butts which tend to skewer data results. 3. Sampling site criteria questionable.
Nebraska	1991	154	No limit	Tobacco products - 32.13% (Fresh litter)	Candy, gum, snack packaging - 13.56% (Fresh litter)	Beer and soft drink containers - 10.94% (Fresh litter)	Napkins, Tissues, Paper bags - 8.78% (Fresh litter)	Other - unidentifiable - 8.62% (Fresh litter)	N/A	N/A	N/A	1. Analyzed Fresh vs. Accumulated Rates. 2. For freshly littered items - decrease of 65% from 1980 and 37% from 1985. 3. Volume measurement decreased by 55% from 1980 and 39% from 1985. 4. Weight decrease by 65% from 1980 and 56% from 1985. 5. Accumulated Count - 8,507 items. 6. Fresh Count - 3,497 items.	1. Unclear where misc. paper and plastics were counted. 2. Included cigarette butts in count.
New Jersey	1989	37	1" or greater	Paper - 29.0% (general and packaging)	Cigarette Butts - 23.2%	Plastic - 14.2% (general and packaging)	Glass - 10.3% (whole & broken pieces)	Styrofoam - 7.8%	N/A	N/A	N/A	1. Initial cleanup and recording. Went back two times to count fresh litter. 2. Counted cigarette butts however also stated only 1" or greater items were counted - this contradicts itself. 3. Only 37 sites (500sq. Ft.) sampled.	

AVG: 201  
<sup>2</sup> Unless otherwise noted. Some numbers have

Table A-3a  
Weight and Volume – Estimated Tons/Year<sup>1</sup>

Weight Based Studies	Year	Sites	Interstates, State Routes and County Roads:	Interchanges:	Farm Maintained Roadways:	TOTAL:
Texas	2005	136	6,200 <sup>2</sup>	N/A	7,200	13,400
Ohio	2004	112	11,380 <sup>3</sup>	392	N/A	11,772
Washington	2004	222	6,315	443	N/A	6,758
Mississippi	2004	108	3.9 pounds <sup>4</sup>	N/A	N/A	N/A

<sup>1</sup> Unless otherwise noted

<sup>2</sup> State Highways, US Highways, and Interstate Highways

<sup>3</sup> Interstate, State, U.S. and County Roads

<sup>4</sup> Average weight per sample site. Includes State Highways, Interstates, U.S. Highways, and MS Highways

Table A-3b  
Weight and Volume – Estimated Tons/Mile<sup>1</sup>

Weight Based Studies	Year	Sites	Interstate Roads	State Routes	County Roads	Interchanges (tons only)	Farm Maintained
Texas	2005	136	0	0.17	N/A	N/A	0.18
Ohio	2004	112	0.83 <sup>2</sup>	0.25	0.12	N/A	N/A
Washington <sup>1</sup>	2004	222	1	0.2	0.11	443	N/A
Nebraska <sup>3</sup>	2001	154	0.28	0.19	0.09	N/A	0.28 <sup>4</sup>
Nebraska <sup>3</sup>	1991	154	0.63	0.38	0.13	N/A	0.21 <sup>4</sup>
Virginia	1977	82	12.47 <sup>5</sup>	1.79 <sup>6</sup>	1.21 <sup>7</sup>	N/A	N/A

<sup>1</sup> Mean results.

<sup>2</sup> Mean. Includes Interstate and U.S.

<sup>3</sup> Accumulated Litter Rates Routes.

<sup>4</sup> Landfill Roads

<sup>5</sup> Rural and Urban interstates.

<sup>6</sup> Arterial + No arterial Primary Highways.

<sup>7</sup> Secondary Highway Roads.

**Table A-3c**  
**Weight and Volume - Product Categories by Weight**

Weight Based Studies	Year	Sites	Organics	Metal	Glass	Plastics	Paper	Top 5 Total
Ohio <sup>1</sup>	2004	112	Plastics - 19.1%	Glass - 17.3%	Paper - 16%	Metal - 12.2%	Organics - 7.7%	72.3%
Washington <sup>2</sup>	2004	222	Metal - 17.3%	Plastics - 14.3%	Organics - 13.3%	Glass - 13%	Paper - 10.6%	68.5%
Virginia	1977	82	Beer, soft drink, liquor, wine - 65.0%	Grocery <sup>3</sup> - 6.0%	Misc. paper - 5.8%	Take out food packaging - 4.2%	Vehicle Debris - 4%	85.0%

<sup>1</sup> U.S. Routes, State Routes, County Roads, Interchanges.

<sup>2</sup> Mean results. Interstates, State Routes and County Roads. Does not include interchanges

<sup>3</sup> Generally a food container or wrapper of some sort with the exception of snack food items. Paper bags identified as coming from a grocery store were included.

**Table A-3d**  
**Weight and Volume - Estimated Volume for All Roadways**

Weight Based Studies	Year	Sites	Cubic Yards
Texas <sup>1</sup>	2005	136	360,000
Ohio <sup>2</sup>	2004	112	132,873
Washington	2004	222	N/A
Mississippi	2004	108	1.47 <sup>3</sup>
Virginia	1977	82	947,049 <sup>4</sup>

<sup>1</sup> Includes State Highways, Farm Maintained Roadways, US Highways, and Interstate Highways

<sup>2</sup> All roads + Interchanges.

<sup>3</sup> Average volume of a single bag per sample site (Statewide, Interstate, US Highway, MS Highway.)

<sup>4</sup> Highway's only (Interstate urban, rural, arterial and non-arterial primary, secondary).